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CVO Data Clearinghouse/Brokerage Facility

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Transport Canada

by
MacDonald, Dettwiler and Associates Ltd.
and the University of British Columbia

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The Transportation Development Centre of Transport Canada served as the technical authority for the project.

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Un sommaire français se trouve avant la table des matières.

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16. Abstract

The purpose of this project was to determine whether implementing a *Data Clearinghouse/ Brokerage Facility* (DCBF) would provide an integrated, information system supporting the goals of efficient and secure commercial transportation within Canada and along the major trade corridors shared with the United States.

The methods used to determine this involved conducting a literature review to assist in developing a concept, creating a demonstration of the concept, and then modelling the concept.

Modelling the concept showed a number of benefits in having a DCBF to manage Commercial Vehicle Operations (CVO) information. Secure trade is of paramount importance to both Canadian and U.S. trading partners. The use of technologies such as pre-screening and DCBF allows the timely acquisition of vital information regarding the goods, carrier, and driver of a commercial vehicle. Efficiency would be improved in terms of operating costs for carriers, border agencies, shippers, and in fuel consumption. Safety information would be distributed in a timely manner. Additional benefits include improving the environment by reducing CO_2 emissions.

Implementing a DCBF would benefit CVO from the security, efficiency and safety perspectives.

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16. Résumé

Le but de ce projet était de déterminer dans quelle mesure la mise en œuvre d'un *Centre de courtage/d'échange de données* (CCED) pourrait, grâce à l'intégration de l'information, améliorer la sécurité et l'efficacité du transport commercial au Canada et dans les principaux corridors de commerce Canada – États-Unis.

L'étude a commencé par une recherche documentaire, qui a aidé à définir un concept technique, suivie d'une démonstration du concept, puis de la modélisation du concept.

La modélisation a révélé un certain nombre d'avantages à disposer d'un CCED pour gérer l'information concernant l'exploitation des véhicules commerciaux (EVC). Ainsi, la sécurité des échanges est primordiale pour les partenaires commerciaux des deux côtés de la frontière. Or, des technologies comme le précontrôle et le CCED permettent d'obtenir rapidement une information vitale sur les marchandises, le transporteur et le conducteur d'un véhicule commercial. D'où une amélioration de l'efficacité, c'est-à-dire une diminution des coûts d'exploitation pour les transporteurs, les agences de douanes et les expéditeurs, et des économies de carburant. Les données de sécurité seraient elles aussi transmises en temps opportun. Ces avantages s'accompagneraient d'une diminution des émissions de CO_2, qui serait bénéfique pour l'environnement.

La mise en œuvre d'un CCED serait avantageuse pour la sécurité, l'efficacité et la sûreté de l'exploitation des véhicules commerciaux.

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EXECUTIVE SUMMARY

The Intelligent Transportation System (ITS) research and development project titled *CVO Data Clearinghouse/Brokerage Facility for Transportation Security and Efficiency* was executed by MacDonald, Dettwiler and Associates Ltd. (MDA) and the University of British Columbia (UBC). MDA developed the concept of the Data Clearinghouse/ Brokerage Facility (DCBF), and UBC modelled the DCBF concept and evaluated the merits of the concept.

Objective

The objective of this research and development project was to determine whether a Data Clearinghouse/Brokerage Facility project would provide an integrated, information system concept that supports the goals of efficient and secure commercial transportation within Canada and along the major trade corridors shared with the United States.

Developing an integrated ITS system requires endorsement through quantitative methods. By taking the task of evaluating the DCBF concept down to a local level, supported with statistics, the size and importance of the task becomes easier to appreciate. This concept project supports a Canada-wide solution. However, the schedule and budgetary constraints of the study limited the project to a single border crossing. The British Columbia Pacific Highway[1] crossing, with interaction between U.S. Customs and Border Protection (CBP) in Washington State and Canada Border Services Agency (CBSA) in British Columbia was selected by the project as a representative crossing.

Project Results

The following describes the original tasks and the results from the project:

- Perform a literature review of the current ITS information and modelling techniques that allow for the definition and validation of the DCBF concept.

  The technology literature review covered aspects of the DCBF concept that needed to be taken into consideration for a future implementation of the system. The review revealed that the ITS Commercial Vehicle Operations (CVO) currently focuses on the safety and efficiency of the commercial vehicle operations. The U.S. and Canada are developing a larger concern for security issues concerning freight and, in particular, container traffic. The traditional approach is to build a system with a single application in mind. This resulted in the public and private industries getting multiple applications but paying for the same infrastructure multiple times. However, the DCBF concept supports cost savings on infrastructures and user accessibility.

[1] The Canada Border Services Agency (CBSA) references the two Blaine Washington crossings as the "Peace Arch" and "Pacific Highway" crossing (www.cbsa-asfc.gc.ca/general/times/menu-e.html). Local users refer to the Pacific Highway as the "Pacific Highway Truck Crossing". This document uses the CBSA definition.

- Focus on using ITS technologies and requirements to allow all stakeholders access to a system that facilitates sharing and distribution of information.

  The DCBF concept approach places emphasis on stakeholders who own their own data to control visibility and access to that data through submitted rules. The DCBF is a data management facility, which allows stakeholders to broker information by controlling what information is exchanged and what rules the information is exchanged under. In addition to the information that is brokered, the DCBF, as a clearinghouse, can create new information from the information received (such as history lines, trends, etc.) that can be distributed to stakeholders. The DCBF concept meets three key criteria:

  a. Efficiency, i.e., lower the costs and speed inspections through the standardization and automation of data exchange.

  b. Information Security, i.e., provide a secure, rule-based exchange of data through a fast, secure mechanism.

  c. Safety, i.e., support more timely identification of potential safety issues though a more complete, controlled, and standardized exchange of data.

- Create a DCBF concept that allows stakeholders to control the information flow through brokerage rules and to make use of available information to allow for clearing of history and trends in the information being processed.

  The DCBF solution will support new levels of decision-making and information security. The DCBF can use rules to integrate information from multiple sources to provide a "higher level" of information service; for example, single source information about a tractor can be integrated with information about the driver, the trailer, the goods, the trucking company, and the e-seal status. This provides a more complete information "picture" about the status of the tractor. For example, the DCBF can use its access to more extensive data and rules to identify anomalous situations and highlight situations that may require closer inspection.

- Create a simple demonstration showing how the concept can be implemented using a small thread of data and XML messaging to communicate that information.

  To validate the concept, a small demonstration system was created to show the functionality of the DCBF as a proof of concept. Selected hypothetical stakeholders and simplified data were used to show the validity of the concept.

- Validate (or invalidate) the concept by having UBC model the Pacific Highway crossing using rules and information maintained by the DCBF.

  The independent modelling of the DCBF verified that the implementation of the DCBF would be beneficial. To demonstrate the benefits, the Pacific Highway crossing was chosen as a location to determine the benefits of DCBF information. In order to evaluate the conceptual DCBF, a total of ten scenarios

were developed with varying degrees of agency/stakeholder participation (in the form of access to database information) and industry participation (in the form of transponder utilization). The results show that the greater the participation by industry, the greater the benefits. The model scenarios ranged from a Base Scenario, which involved no agency or industry participation, to Scenario 10, which covered high agency and industry participation. The key benefits identified from the modelling were:

a. Average primary inspection service time of 70 seconds for the Base Scenario, to a low of 44.3 seconds for Scenario 10 (high agency participation and 100% industry participation).

b. The fuel consumption ranged from an average of 253 ml of diesel fuel in the base scenario of a truck passing through the primary inspection service, to an average of 47 ml per truck for Scenario 10.

c. The CO_2 Air Emission for a delayed commercial vehicle ranges from a high of 669 grams of CO_2 emitted by the average commercial vehicle in the Base Scenario to a low of 126 grams per vehicle for Scenario 10.

- Summarize the benefits and plans for future development of the DCBF concept.

  The DCBF solution provides for efficient movement of goods across the Canadian–U.S. border through the use of standardized and automated data exchange. This results in the reduction of time, and therefore costs required to pass through the border inspection services. The DCBF's standardized data exchange also allows for the provision of a fast and secure rules-based exchange of data. With the expedited movement of trucks across the border, additional benefits in the form of reduced emissions and fuel consumption and other benefits can be realized. These benefits formed the basis of the evaluation framework that was applied to estimate the potential benefits of a DCBF implementation of varying degree. Other benefits include:

  a. Economic benefits from the spillover effects of a more efficient and secure border.

  b. Productivity benefits of border inspection services through reduced need for border staffing/resources, or alternatively, increased efficiency in the delivery of border services.

  c. Effectiveness benefits by increasing the feasibility of just-in-time transportation of highly time-sensitive cargo.

  d. Safety benefits of knowing contents of cargo and their arrival times in advance to better prepare for sensitive or dangerous/hazardous cargo, as well as knowledge of the physical condition of trucks via on-board sensors in the future.

  e. Positive multiplication effect of adapting technologies and standards that can benefit the commercial vehicle industry beyond the border

(e.g., encouraging adoption and use of transponders can help in efficient weighing and safety inspections).

The DCBF concept shows that benefits derived from utilizing a DCBF would improve security, safety and the economics of the CVO industry. The management of CVO information, along with full participation of stakeholders, would create a more efficient and cleaner solution to CVO. The DCBF, as a hub for the information, would allow for stakeholders to interface their legacy systems to the DCBF. The DCBF would allow stakeholders to involve their systems, without incurring the cost of scheduling and designing multiple interfaces to the numerous stakeholders for which they are required to exchange information.

The key Canadian stakeholder for Canadian security is Public Safety and Emergency Preparedness Canada. This federal department is now responsible for ensuring national safety and security, including border security; immigration; chemical, biological, radiological, and nuclear threats; and emergency information. CVO safety concerns fall under the mandate of the provincial and territorial governments. Economics of CVO falls to the shippers, brokers, and trucking agencies. The DCBF concept supports expansion on all three levels (security, safety and economics). With additional involvement of provincial, public safety and economic interests, the DCBF could be integrated within these Canadian stakeholders. Currently the Canadian Council of Motor Transport Administrators (CCMTA) has a mandate that supports the economic participants and would be an ideal candidate to become involved in a economic stakeholder interest. Provincial interest would be required to be negotiated by each province and territory. The national security interest would require the involvement of Public Safety and Emergency Preparedness Canada.

The number of stakeholders involved requires that a champion from the stakeholder group be found. This report recommends the champion to develop a coordinated approach across all of the stakeholders to create a pilot project that implements the technology in a small area to allow its benefits to be properly evaluated in a realistic operational setting. The DCBF project recommends that the prototype be developed in the Lower Mainland B.C. This area is a tightly defined transportation area, with physical borders of the ocean, mountains, and the U.S. border to confine the area that would be required for the pilot project. The Cost Benefit Study[2] recommendation states "Operationally it makes the most sense to complete implementation sequentially along the National Highway System so there is a coherent linear system of Electronic Clearance and Roadside Inspection (ECRI) equipped stations". The Lower Mainland allows for the maximum of evaluation to occur with the minimum amount of area to invest in.

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[2] *Cost Benefit Study of Electronic Clearance and Roadside Inspection (ECRI) for Canada*, by Tri-Global Solutions Group Inc. and the IBI Group, June 2003.

SOMMAIRE

Le projet de R&D en systèmes de transports intelligents (STI) intitulé *Centre de courtage/d'échange de données sur l'exploitation des véhicules commerciaux pour améliorer la sécurité et l'efficacité des transports* a été exécuté par MacDonald, Dettwiler and Associates Ltd. (MDA) et l'Université de Colombie-Britannique (UCB). MDA a élaboré le concept technique du Centre de courtage/d'échange de données (CCED), et l'UCB a modélisé le concept et en a fait l'évaluation.

Objectif

Ce projet de R&D avait pour but de déterminer dans quelle mesure la mise en œuvre d'un Centre de courtage/d'échange de données pourrait, grâce à l'intégration de l'information, améliorer la sécurité et l'efficacité du transport commercial au Canada et dans les principaux corridors de commerce Canada – États-Unis.

L'élaboration d'un système STI intégré passe obligatoirement par des méthodes quantitatives. Pour ce qui est de l'évaluation du concept de CCED, les chercheurs ont convenu de simplifier cette tâche en lui donnant une portée locale, quitte à étayer leurs résultats d'analyses statistiques. Certes, le concept doit être applicable partout au Canada. Mais en raison de contraintes temporelles et budgétaires, l'étude a été limitée à un seul poste frontalier. C'est le poste Pacific Highway[3] de Colombie-Britannique, où sont présents, d'une part, le Bureau des douanes et de la protection des frontières (*Customs and Border Protection*) des États-Unis, dans l'État de Washington et, d'autre part, l'Agence des services frontaliers du Canada (ASFC), en Colombie-Britannique, qui a été retenu aux fins de la recherche, étant jugé suffisamment représentatif.

Résultats

Voici les tâches que comportait le projet et les résultats obtenus :

- Effectuer une recherche documentaire sur la situation actuelle des STI et sur les techniques de modélisation pouvant servir à définir et valider le concept de CCED.

  La revue de la littérature technologique a porté sur les aspects du concept de CCED qui doivent être pris en compte en prévision d'une mise en œuvre future du système. La revue a révélé que présentement, le volet Exploitation des véhicules commerciaux (EVC) des STI s'intéresse surtout à la sûreté et à l'efficacité du transport routier. Les États-Unis et le Canada sont de plus en plus préoccupés des questions de sécurité touchant les expéditions de

[3] L'Agence des services frontaliers du Canada (ASFC) désigne *Peace Arch* et *Pacific Highway*, les deux postes frontaliers de Blaine, Washington (www.cbsa-asfc.gc.ca/general/times/menu-f.html). Les utilisateurs locaux désignent le poste Pacific Highway «Pacific Highway Truck Crossing». Ce document utilise la désignation de l'ASFC.

marchandises, et en particulier le trafic des conteneurs. Jusqu'à maintenant, lorsqu'on construisait un système, c'était pour une application unique. C'est ainsi que les organismes publics et privés se dotaient de plusieurs applications, mais payaient plusieurs fois pour la même infrastructure. Contrairement à cela, le concept du CCED favorise les économies dans les infrastructures,
et l'accessibilité des utilisateurs.

- Se pencher sur l'utilisation des technologies et normes STI pour mettre en place un système qui facilite la mise en commun et la transmission de l'information.

  Le concept de CCED prévoit que les intervenants sont propriétaires de leurs propres données et qu'ils en contrôlent la visibilité et l'accès, selon certaines règles. Le CCED est un centre de gestion de données qui permet aux intervenants de contrôler les renseignements échangés et les règles d'échange de ces données. Le CCED ne sert pas uniquement au transit d'information : il peut aussi créer, à partir des données qu'il reçoit, de nouveaux éléments d'information (historique, tendances, etc.) dont les intervenants peuvent prendre connaissance. Le concept de CCED répond à trois critères :

  a. Efficacité : accélérer les inspections et en abaisser les coûts, par la normalisation et l'automatisation de l'échange des données.

  b. Sécurité (confidentialité) de l'information : assurer un échange des données sécuritaire et fondé sur des règles, par la mise en place d'un mécanisme sûr et à action rapide.

  c. Sûreté (innocuité) : permettre une reconnaissance plus rapide des menaces potentielles à la sûreté, par un échange plus complet, contrôlé et normalisé des données.

- Créer un concept de CCED qui permet aux intervenants de contrôler le flux de l'information par l'application de règles, et qui utilise l'information traitée pour dégager des historiques et des tendances.

  Le CCED est de nature à améliorer les prises de décisions et la sécurité-confidentialité de l'information. Le CCED peut appliquer des règles pour l'intégration de données provenant de plusieurs sources, de façon à offrir un service d'information de «haut niveau»; par exemple, une donnée provenant d'une source unique concernant un tracteur peut être intégrée à des données concernant le conducteur, la remorque, les marchandises, le transporteur, et l'état du cachet électronique. Cela donne un «tableau» plus complet du tracteur en question. Autre exemple, le CCED peut utiliser sa capacité d'accès à un ensemble plus complet de données et de règles pour repérer des situations anormales et signaler des cas où un examen approfondi s'impose.

- Créer une démonstration à petite échelle pour illustrer comment le concept peut être mis en œuvre, à l'aide d'un petit ensemble de données et de la messagerie XML.

  Pour valider le concept, les chercheurs ont créé un petit système de démonstration, qui a servi à illustrer le fonctionnement du CCED. Ils ont utilisé pour ces travaux des intervenants hypothétiques et un ensemble limité de données.

- Valider (ou invalider) le concept en chargeant l'UCB de créer un modèle du poste frontalier Pacific Highway qui respecte les règles et contient les données prévues par le concept de CCED.

  La modélisation du CCED par un organisme distinct a confirmé que la mise en œuvre d'un CCED comporterait des avantages. Le poste Pacific Highway a été retenu pour la démonstration de ces avantages. Aux fins de l'évaluation du modèle de CCED, dix scénarios ont été élaborés, lesquels comportaient divers degrés de participation de la part des organismes/intervenants (accès aux bases de données) et de la part de l'industrie (utilisation des transpondeurs). Les résultats révèlent que les avantages à tirer d'un CCED sont à la mesure de la participation de l'industrie. Les scénarios imaginés allaient d'un scénario de base, qui ne nécessitait pas la participation d'intervenants ou de l'industrie,
  au scénario 10, qui supposait une forte participation des intervenants et de l'industrie. Voici les grands avantages mis en lumière par la modélisation :

  a. Le service d'inspection primaire a duré en moyenne 70 secondes, dans le scénario de base, par rapport à 44,3 secondes, dans le scénario 10 (forte participation de l'agence et 100 p. 100 de participation de l'industrie).

  b. La consommation moyenne de carburant diesel s'est établie à 253 ml par camion soumis au service d'inspection primaire, dans le scénario de base, à 47 ml par camion, dans le scénario 10.

  c. La quantité de CO_2 émise dans l'atmosphère par un véhicule commercial mis en attente va de 669 grammes, pour le véhicule commercial moyen dans le scénario de base, à 126 grammes par véhicule, dans le scénario 10.

- Résumer les avantages associés au CCED et esquisser des plans de développement futur du concept de CCED.

  Le CCED assure des mouvements efficaces de marchandises à la frontière Canada – États-Unis, grâce à un échange normalisé et automatisé des données. Il s'ensuit une diminution du temps, et partant, des coûts des services d'inspection à la frontière. Le CCED permet aussi un échange de données rapide et sécurisé, fondé sur des règles précises. Mis à part le mouvement accéléré des camions aux postes frontières, le CCED offre

d'autres avantages, soit, notamment, une diminution des émissions et de la consommation de carburant. Ces avantages ont servi de critères pour l'évaluation des avantages potentiels reliés à une mise en œuvre plus ou moins complète d'un CCED. Voici d'autres avantages :

a. Avantages économiques rejaillissant d'activités plus efficaces et plus sécuritaires à la frontière.

b. Gains de productivité des services d'inspection à la frontière, par une diminution des besoins en personne/ressources, ou une plus grande efficacité dans la prestation des services à la frontière.

c. Gains d'efficacité, par l'accroissement de la faisabilité du transport «juste-à-temps» de marchandises à délai de livraison critique.

d. Sécurité accrue : le fait de connaître à l'avance le contenu des expéditions et leur heure d'arrivée permet de mieux préparer l'arrivée de marchandises sensibles ou dangereuses; aussi, il sera possible dans l'avenir de connaître l'état mécanique des camions, au moyen de capteurs embarqués.

e. Effet multiplicateur positif de l'adaptation de technologies et de normes susceptibles de bénéficier à l'industrie du transport ailleurs qu'aux frontières (p. ex., l'utilisation de transpondeurs peut contribuer à rendre plus efficaces le pesage et les inspections de sécurité).

L'évaluation du concept de CCED indique que l'utilisation d'un CCED mènerait à une amélioration de la sécurité et de la sûreté, et à des économies dans le secteur du transport par véhicules commerciaux. En effet, la gestion de l'information sur l'exploitation des véhicules commerciaux, combinée à la pleine participation des intervenants, permettrait une exploitation plus efficace et plus transparente des véhicules commerciaux. Le CCED étant un carrefour de données, les intervenants pourraient interfacer leurs systèmes existants au CCED. Ils n'auraient donc pas à assumer les coûts de multiples interfaces avec les nombreux intervenants avec qui ils doivent échanger de l'information.

Le principal intervenant canadien en matière de sécurité est Sécurité publique et Protection civile Canada. Il s'agit du ministère fédéral qui a pour mandat d'assurer la sécurité nationale, y compris la sécurité à la frontière, la sécurité en matière d'immigration, la lutte contre les risques chimiques, biologiques, radiologiques et nucléaires, et de diffuser l'information dans les situations d'urgence. La sûreté de l'EVC relève du mandat des gouvernements des provinces et des territoires. L'aspect économique de l'EVC est la responsabilité des expéditeurs, des courtiers et des entreprises de camionnage. Le concept de CCED est ouvert et permet donc l'ajout d'intervenants des trois sphères (sécurité, sûreté et économie). Le CCED peut être adapté à la venue de tout nouvel intervenant représentant les provinces, la sécurité publique ou des intérêts économiques. Présentement, le Conseil canadien des

administrateurs en transport motorisé (CCATM) a un mandat surtout axé sur l'économie. Il serait un candidat idéal pour représenter les intérêts économiques. La participation des provinces devrait être négociée avec chaque province et territoire. Dans l'intérêt de la sécurité nationale, Sécurité publique et Protection civile Canada devrait prendre part au CCED.

Compte tenu du nombre d'intervenants, il y aura lieu de désigner un «champion» parmi les participants. Le rapport recommande de confier à cette personne la tâche de rallier l'ensemble des intervenants à la mise sur pied d'un projet pilote pour mettre en œuvre la technologie à petite échelle, afin d'évaluer ses avantages en situation réelle. L'équipe de projet recommande de réaliser le projet pilote dans le Lower Mainland, en Colombie-Britannique. Cette région, délimitée par l'océan, les montagnes et la frontière avec les États-Unis, possède des contours définis qui se prêtent bien au projet pilote. Selon l'étude coûts-avantages[4], sur le plan opérationnel, le plus logique est de procéder à une mise en œuvre séquentielle dans le réseau routier national, de façon à obtenir une suite linéaire cohérente de postes équipés de dispositifs électroniques de dédouanement et d'inspection. Le caractère «concentré» du Lower Mainland permet de maximiser l'évaluation, moyennant un minimum d'investissement.

[4] *Étude coûts-avantages relative au dédouanement électronique et à l'inspection routière au Canada*, Tri-Global Solutions Group Inc. et Groupe IBI, juin 2003.

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GLOSSARY

API	Application Programming Interface
AVI	Automated Vehicle Identification
AVL	Automatic Vehicle Location
B.C.	British Columbia
BC ITS	British Columbia Intelligent Transportation System
BCMOT	British Columbia Ministry of Transportation
BC-SG	British Columbia Solicitor General
CBP	Customs and Border Protection (U.S.)
CBSA	Canada Border Services Agency (formerly part of CCRA)
CCMTA	Canadian Council of Motor Transport Administrators
CCRA	Canada Customs and Revenue Agency
CDAC	CDE – Accident Record
CDE	Carrier Data Exchange
CDIN	CDE – Inspection Record
COTS	Commercial Off-The-Shelf
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial Vehicle Operations
DB	Database
DCBF	Data Clearinghouse/Brokerage Facility
DMZ	Demilitarized Zone
DNS	Domain Name Server
DTD	Document Type Definition
ECRI	Electronic Clearance and Roadside Inspection
EDI	Electronic Data Interchange
ETA	Estimated Time of Arrival
FAST	Free and Secure Trade
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
HAZMAT	Hazardous Material
HTTP	Hyper Text Transfer Protocol
ICBC	Insurance Corporation of British Columbia

ID	Identification
IMTC	International Mobility and Trade Corridor
IRE	Inter-provincial Record Exchange
ITS	Intelligent Transportation System
IVV	Inspection Verification and Validation
J2EE	Java 2 Platform, Enterprise Edition
JDB	Jane Doe Brokers
JMS	Java Messaging Services (Java API)
LAN	Local Area Network
LEIP	Law Enforcement Information Portal
MDA	MacDonald, Dettwiler and Associates Ltd.
MOE	Measure of Effectiveness
NSC	National Safety Code
NSDR	National Safety CDE – Driver Table
NSUC	National Safety CDE – NSC Contravention update history
NSUH	National Safety CDE – NSC Accident update history
PC	Personal Computer
R&D	Research and Development
RAID	Redundant Array of Independent Disks
RDBMS	Relational Database Management System
SAFER	Safety and Fitness Electronic Records system
SG	Solicitor General
SOAP	Simple Object Access Protocol (XML protocol)
SQL	Structured Query Language
TC	Transport Canada
TCA	Trucking Company A (Generic Trucking Company)
TCOS	Trade Corridor Operations System
UBC	University of British Columbia
USCS	United States Customs Service (part of CBP)
VPN	Virtual Private Network
WIM	Weigh-In-Motion
WSDOT	Washington State Department of Transportation
XML	Extensible Markup Language

1 INTRODUCTION

This is the final report on the Data Clearinghouse/Brokerage Facility prepared by MacDonald, Dettwiler and Associates Ltd. for Transport Canada. The project required MDA to define a **Data Clearinghouse/Brokerage Facility** (DCBF) concept, a technology to integrate current stakeholder information systems, e-seals, and Automatic Vehicle Locations (AVL) to provide an enhanced capability to achieve two key goals:

1. **Security**—DCBF concept allows stakeholders to ensure the security of transport. The system supports data collection over time and throughout the system. The system identifies when a sealed container was loaded, the weight of the load, the truck movements, the weight of the truck en route, the activities of the driver, and the profile of the transportation company as well as the shipping agency. The system distinguishes suspicious anomalies from normal operational data to help minimize the effort for customs and security personnel determining the need to detain or inspect low-risk shipments.
2. **Economic efficiency**—There are many opportunities for efficiency. For example, the information made available through DCBF about the driver, the tractor, the trailer, the containers, the electronic driving logs, and the truck's route and reported locations can be used by inspection authorities to make decisions about who to inspect. This will reduce the time spent by trucks undergoing inspection and will result in large economic benefits.

Successful security requires seamlessly integrating many systems while providing timely access to data and assurance that the data is valid. Current Intelligent Transportation System (ITS) integration efforts are focused on data gathering and efficient processing. But this approach overlooks key areas where more work needs to be done:

- Develop a cross-agency data mechanism to support a higher-level understanding of the situation. Even with the specified national ITS architectures in Canada and the U.S., the many agencies and organizations with data act as repositories but do not support analysis and interpretation. Sophisticated data analysis requires access to cross-agency data and the kind of processing that extracts the broader picture of the overall situation.

- Develop monitoring techniques (algorithms) to assist in the identification of a potential threat or high-risk situation.
- Develop a system modelling approach that will allow decision makers to evaluate the benefits of the proposed cross-agency data mechanism with model analysis capabilities.

2 THE DCBF CONCEPT

This section defines the architectural concept for the DCBF (Data Clearinghouse/ Brokerage Facility).

The first phase of the project involved a literature review [1] that covered aspects of the DCBF concept that needed to be taken into consideration for a future implementation of the system. The review revealed that the current state of the ITS Commercial Vehicle Operations (CVO) world has a major implementation focus on safety and efficiency of the commercial vehicle operations. The U.S. and Canada are developing a larger concern for security issues regarding freight and, in particular, container traffic. The 20th century approach was to build a system with a single application in mind. This resulted in the public and private industries getting multiple applications but paying for the same infrastructure multiple times. Rather than follow the 20th century individual system approach on a broad basis (national and international), the DCBF concept points to a 21st century approach to support cost savings on infrastructures and user accessibility.

In order to emphasize the broad applicability of this architecture, the architecture and its key design elements are discussed in broad terms. The reader is provided with a generic discussion of this architecture and the technical details of how it works, without specifics of collaborating institutions, specific messages exchanged, or the specific rules to be enforced. For these details, the reader is referred to Section 4 for a discussion of the specifics of this project's demonstration mock-up, i.e., the representative collaborations and the types of rules that were implemented to demonstrate the validity of this architectural concept. To summarize:

- Section 2 describes the generic DCBF architecture.
- Section 3 describes the application of DCBF to CVO in British Columbia (B.C.)
- Section 4 describes the details of a demonstration version of the DCBF.

This separation of architecture from implementation is intentional. It is meant to emphasize the fact that this architectural solution can be deployed at many different levels of integration. Figure 2-1 shows that the concept is applicable to CVO at three

geographic levels. Beyond mere geographical scope, the reader should be aware that this architecture is appropriate for solving other data interchange problems for a variety of transportation systems. Indeed, it provides data exchange solutions for applications outside the transportation domain.

Figure 2-1 DCBF Can Be a Common Architectural Element

2.1 Motivation for the Concept

The DCBF exploits new technologies to solve two key problems:

- Cost-effective information exchange
- Controlled, secure integration of data

Figure 2-2 is a simple illustration of who can participate in the exchange of information and notes key elements of the system, i.e., the request/reply mechanism for exchanging data and the rule base to control the exchange of data.

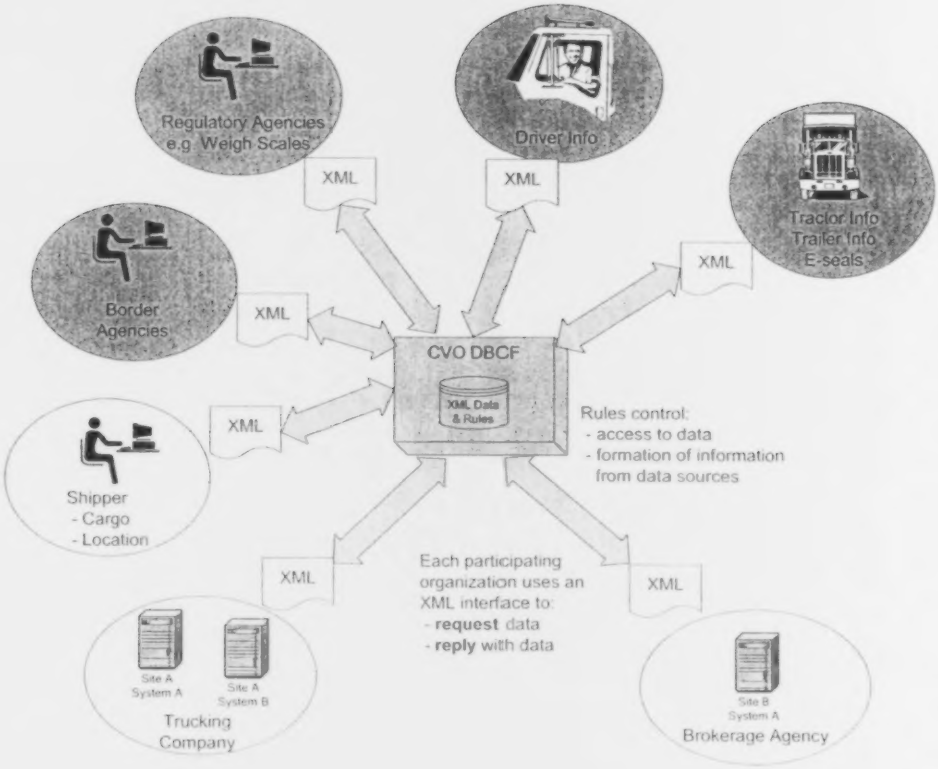

Figure 2-2 DCBF Information Exchange

Figure 2-3 illustrates that the DCBF can support many levels of stakeholder participation and provides a simplified overview of the main components of the facility. Sections 2.2 to 2.4 explore the architecture in depth.

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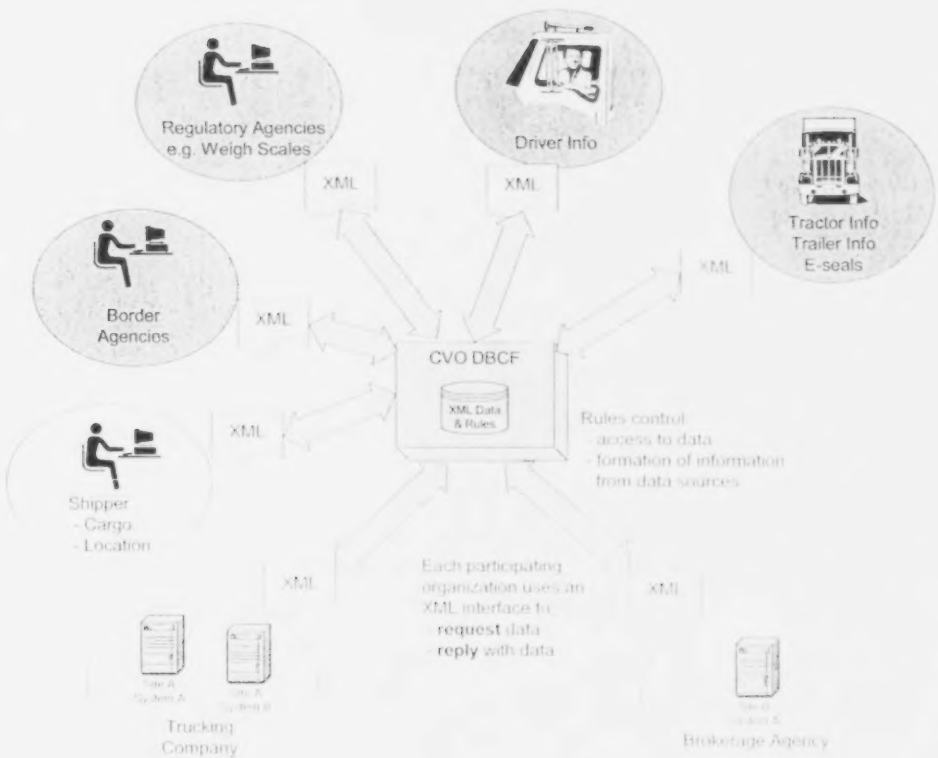

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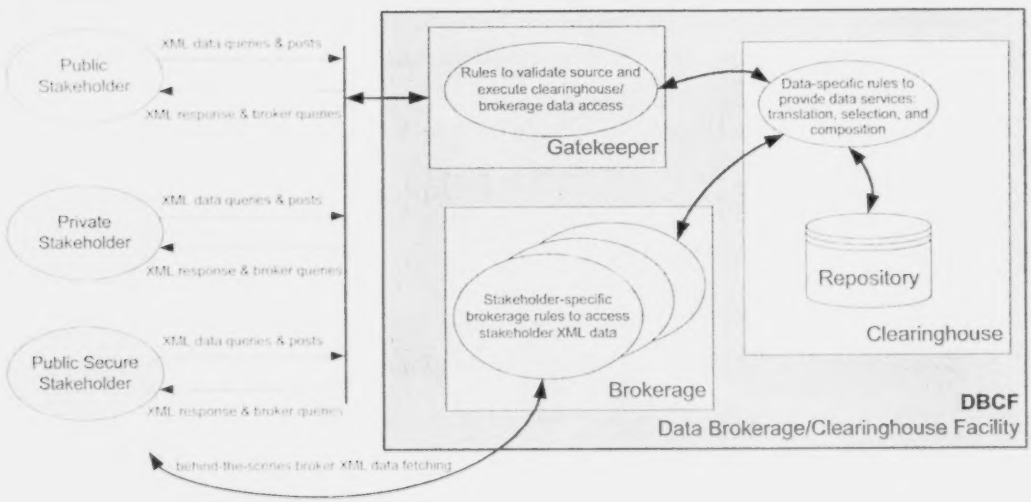

Public Stakeholder
XML data queries & posts
XML response & broker queries
Private Stakeholder
XML data queries & posts
XML response & broker queries
Public Secure Stakeholder
XML data queries & posts
XML response & broker queries
behind-the-scenes broker XML data fetching
Rules to validate source and execute clearinghouse/ brokerage data access
Gatekeeper
Data-specific rules to provide data services: translation, selection, and composition
Repository
Clearinghouse
Stakeholder-specific brokerage rules to access stakeholder XML data
Brokerage
DBCF
Data Brokerage/Clearinghouse Facility

Figure 2-3 Stakeholder Participation

The following key concepts are enforced by the DCBF:

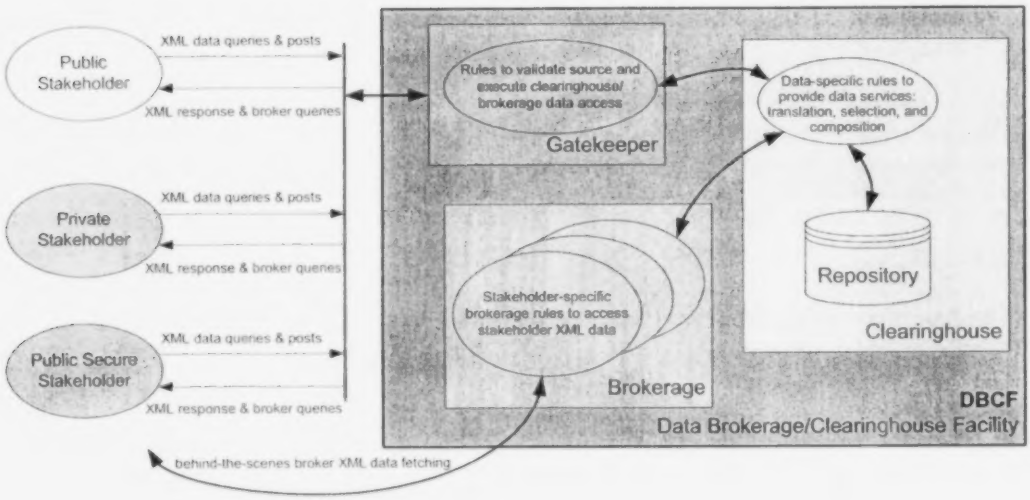
- Stakeholders own their own data and control the visibility and access to their data through rules submitted with the XML schema.
- Brokerage is for data that remains with the stakeholder. The DCBF manages the rules to provide secure access to the data.
- Clearinghouse is for data the stakeholder gives to the DCBF to hold. The DCBF manages the rules to provide access.

The DCBF solution meets three key criteria:

1. Efficiency – lower the costs and speed inspections through the standardization and automation of data exchange.
2. Security – provide a secure, rule-based exchange of data through a fast, secure mechanism.
3. Safety – support a more timely identification of potential safety issues though a more complete, controlled, and standardized exchange of data.

The DCBF solution supports new levels of decision making and security:

- The DCBF can use rules to integrate information from multiple sources to provide a "higher level" of information service, i.e., single source information about a tractor can be integrated with information about the driver, the trailer, the goods, the trucking company, and the e-seal status to provide a more complete information "picture" about the status of the tractor.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- The DCBF can use its access to more extensive data and rules to identify anomalous situations and highlight situations that may require closer inspection.

This project is a research and development (R&D) proof-of-concept. Only selected stakeholders and simplified data services are provided to show the validity of the concept.

2.2 Architectural Overview

2.2.1 Extensible Markup Language (XML)

Proposed is the use of XML as the technology for data interchange between stakeholder systems and the Operational DCBF System, and within the system to facilitate the use of XML-enabled Commercial Off-The-Shelf (COTS) components.

XML is a technology that supports cross-platform application interoperability. XML is rapidly becoming a widespread mechanism for enterprise systems deployment. Communicating applications need not share a common development model, net protocol, operating system, database or programming language, as long as they can exchange and interpret documents, messages and other objects formatted in XML. Senders and recipients of XML-formatted objects are free to process the objects as they wish, without being tightly bound to each other. Many COTS vendors are implementing XML in their core product architectures.

2.2.2 N-Tier Architecture

The DCBF architecture follows the proven n-tier architectural design pattern, as illustrated in Figure 2-4:

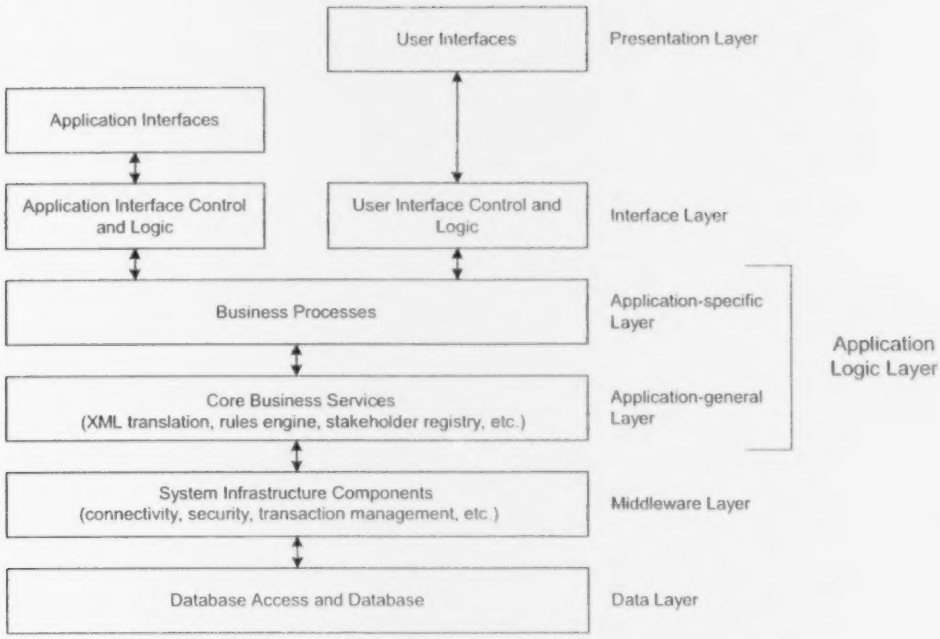

Figure 2-4 DCBF N-Tier Architecture

Logical n-tier architectures define layers, or tiers, of a system in an abstract sense. The logical architecture does not define whether all the tiers run on a single computer or whether they are spread out across many computers. In a large system such as the Operational DCBF System, clearly several computers are needed; the n-tier architecture model provides an organized framework to define such a configuration.

To build complex systems with many concurrent users, typically the n-tier architecture model is followed. This architecture has evolved from the old monolithic and the client/server configurations and provides greater flexibility, scalability, and reliability. The n-tier architecture comprises the following major layers, as illustrated in Figure 2-4:

- Presentation Layer—presents information to interactive users and receives input from users.
- Interface Layer—provides access to the system's application logic for interactive users (e.g., from client workstations) and for external systems (e.g., connecting via a Local Area Network (LAN), the Internet, or Electronic Data Interchange (EDI)).
- Application Logic Layer—implements the business rules and application functionality such as processing Producer accounting information. The Application Logic Layer consists of two layers, one for business-specific rules and processing, and the other for XML translations, stakeholder registry rule engines and other business-type applications.

- Middleware Layer—contains infrastructure components that implement functionality such as transaction management, connectivity and security.
- Database Access and Database—keeps data storage and maintenance separate from the business logic. The data layer implements storage of the data, access to the data, and maintenance of data integrity (e.g., via stored procedures). Data is typically hosted on one or more data servers in the data layer.

The n-tier architecture brings the following benefits:

- Separation of presentation detail from the business logic
- Separation of data storage and data integrity maintenance from the business logic
- Ability to optimize each tier in isolation for scaling, performance, and security
- Ability to configure an efficient distributed system
- Easier system development and maintenance
- Sharing of functional parts (components)
- Ability to select the best platform for each component

The physical architecture of a system takes the abstract logical architecture and physically places the various tiers on specific hardware. The user interface is placed on client workstations, while the application logic is typically mapped to specialized application servers, and the data layer is placed on dedicated database servers. For large systems, the database servers use high-volume, highly reliable storage hardware such as multi-channel RAID arrays.

Figure 2-5 shows a typical mapping from the logical tiers to physical tiers.

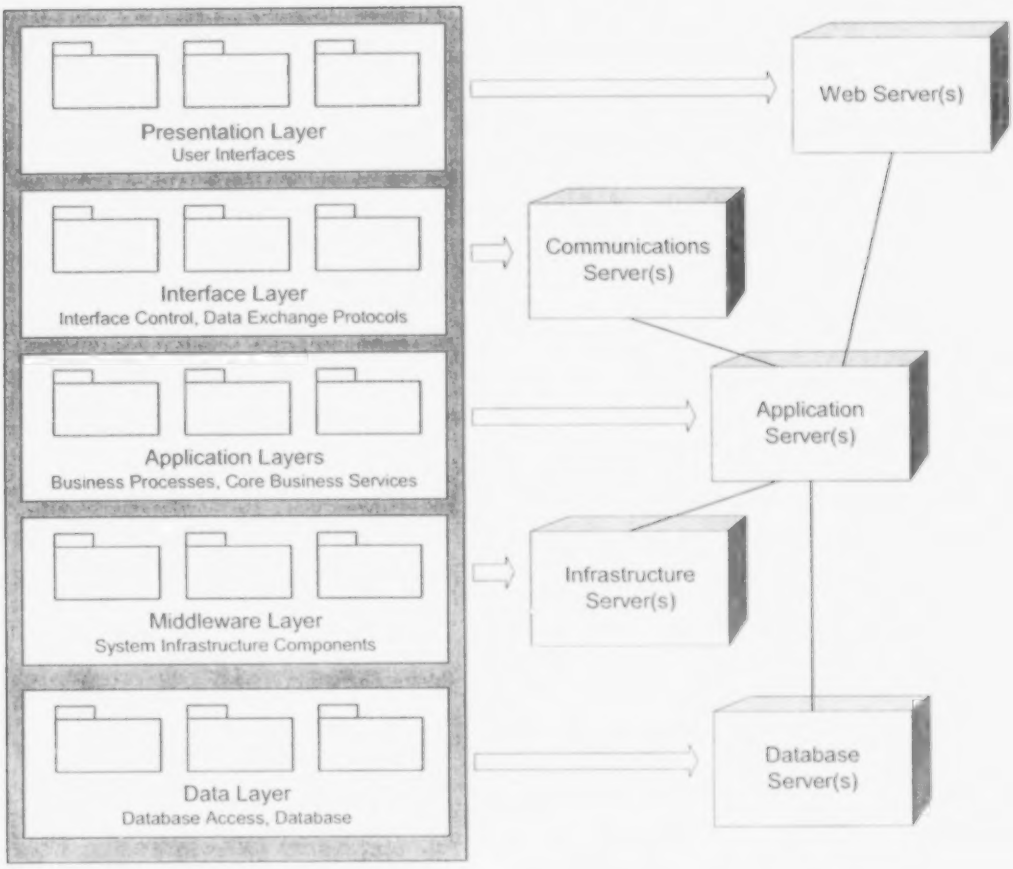

Figure 2-5 Mapping of Logical Tiers to Physical Tiers

2.2.3 XML Rule Engine

This research project implemented a simple rule system to demonstrate the feasibility of the approach. The Operational DCBF System will be designed to use an appropriate sophisticated rule engine.

Key elements of the rule engine:

- Metadata Dictionary—maintains the XML Schema and Document Type Definitions (DTDs). XML Schema is defined by the international standards for XML as the rules and descriptions of the data that is exchanged. The world standards for using XML can be found on the Internet at http://www.w3.org/XML/.

- Composition Rules—for each data item, the two-way mapping rules that identify sub-elements below this item as well as super-elements that include this data item as an element.
- Access Rules—for each data item, the owner of the data item and the set of visibility rules provided by the owner, i.e., the identification of which stakeholders have a right to access the data item and any limitations on those rights.
- Transformation Rules—for each data item, the mapping between data items to allow the instantiation of items that derive data from other items and any formatting rules to apply on the transformation.

The Operational DCBF System will include a Rule Editor to provide a tool to easily update the rule engine, but in this research project this was not developed.

2.3 Key Architectural Components

This section discusses the key components of the application-specific layer seen in Figure 2-4.

The application-general layer is composed of the following commercial components:

- XML parser
- XML translator
- Logic (rules) engine
- Stakeholder registry

2.3.1 Gatekeeper Component

The Gatekeeper Component is responsible for controlling access to the DCBF and providing access to either the Clearinghouse or the Brokerage. The Gatekeeper Component validates users and the data that is being received or requested prior to allowing the request to be sent to the brokerage or clearinghouse components. Figure 2-6 shows the main elements of this component and its interaction with other parts of the system.

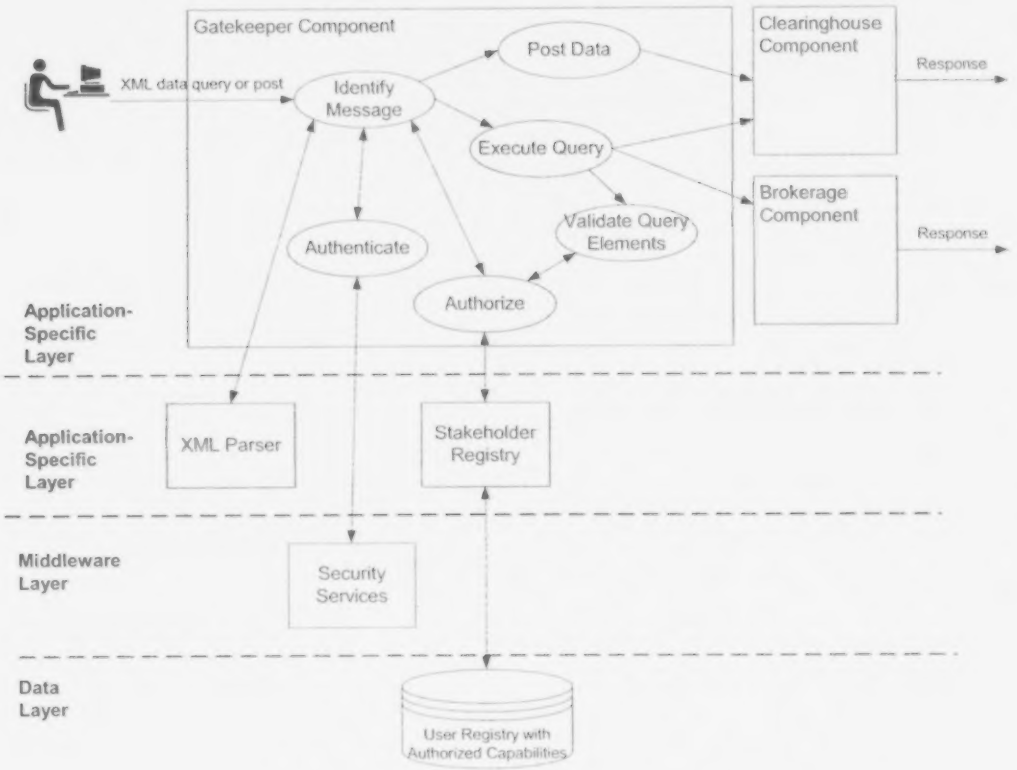

Figure 2-6 Gatekeeper Component

The common container for all XML messages handled by the DCBF is:

```
<DCBF message>
    <Stakeholder ID>  </Stakeholder ID>
    <MSG type>  </MSG type>
    <MSG body>
        … message body depending on the message type…
    </MSG body>
</DCBF message>
```

There are two allowable <MSG type>: POST and QUERY.

If the <MSG type> is POST, then appropriate content for that type must be present.

Similarly, if the <MSG type> is QUERY, the appropriate content for that type must be present.

2.3.2 Clearinghouse Component

The Clearinghouse Component is responsible for managing the rules and data stored at the non-profit corporation's facilities. Figure 2-7 shows the main elements of this component.

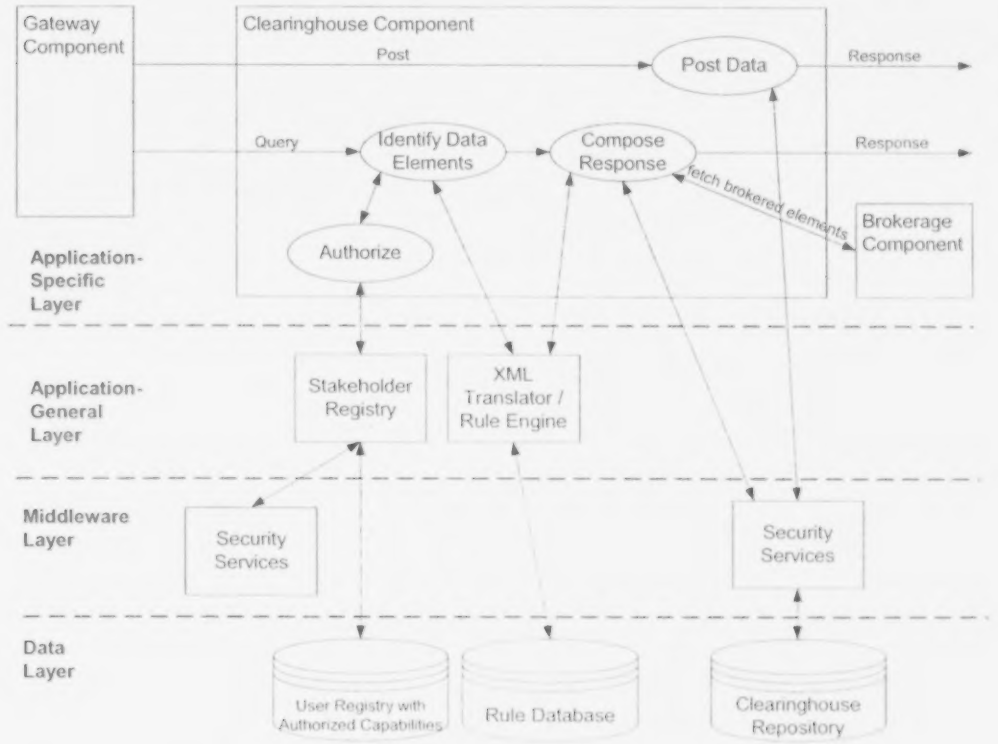

Figure 2-7 Clearinghouse Component

2.3.3 Brokerage Component

The Brokerage Component is for management of data that remains with the stakeholder. The Brokerage Component is responsible for the secure interface to data held by stakeholders but to be made available strictly through the specific stakeholder's interface and strictly according to the access rules supplied by that stakeholder to the DCBF. Each stakeholder needs to provide the rules of who are permitted users (other stakeholders) and what data they are allowed to access from that stakeholder. The Brokerage Component uses these access and data rules to validate each request for stakeholder data. If permitted, then the Brokerage Component fetches the data from the brokered stakeholder's facility to return to the permitted other stakeholder.

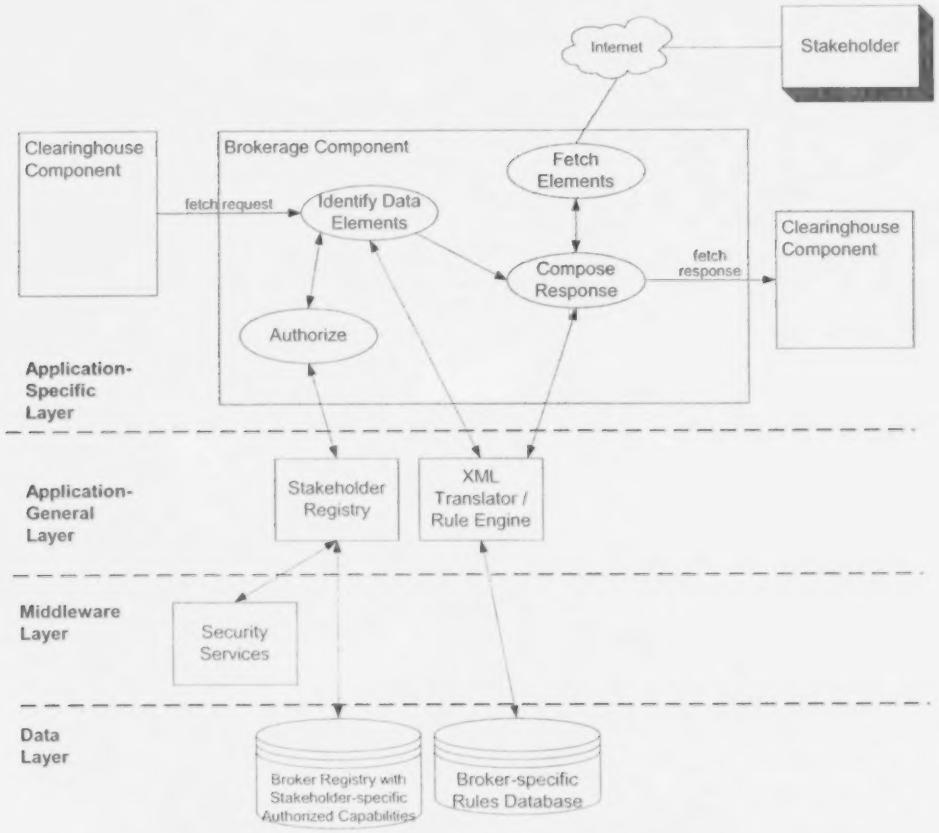

Figure 2-8 Brokerage Component

2.4 The Operational Vision

The Operational Vision supports the DCBF Operational System connecting to the legacy and new systems via the Internet with optional interfaces to provincial local networks and the IRE/CDE networks.[5] Public service functions and requirements were covered by two previous Transport Canada studies [2, 3], which showed a number of options on the way forward. The DCBF concept supports all of the solutions outlined in these two studies. The DCBF solution also allows for the support of functions and requirements of shippers, brokers, carriers and truckers. The DCBF architecture allows the DCBF Operational System to be hosted at the CCMTA and have the connections to the IRE and

[5] CCMTA was informed about the potential for a DCBF to connect to the IRE/CDE networks, and that the study would recommend as an option that the DCBF be hosted by the CCMTA. No further work has been done to explore this potential.

CDE networks be made there, or hosted elsewhere and then connect to the CCMTA via the Internet.

Figure 2-9 shows the proposed system segments: Development, Staging, and Production.

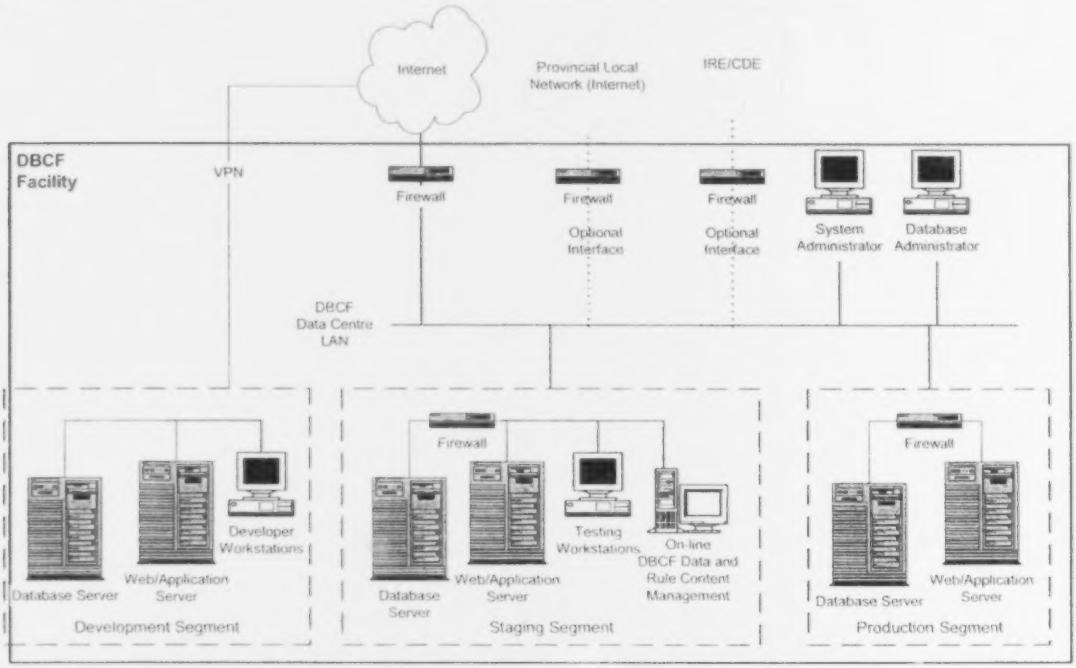

Figure 2-9 DCBF Operational System

The software development and test teams will use the Development Segment to support the evolution of the Operational DCBF System. A Virtual Private Network (VPN) between the Development segment and the Staging/Production segments facilitates support of the operational system by the development staff (e.g., to assist in monitoring and troubleshooting).

The Staging segment will be used to test software and published data updates before they are hosted on the operational system. In order to ensure that all tests are realistic, the Staging segment has a configuration that is functionally equivalent to the Production segment.

The Production segment is highly scalable and highly reliable. Because of the built-in redundancy and fail-over capability of the hardware components (e.g., redundant disks, multiple processors) and the ability of the system software to reconfigure when a point of hardware or firmware failure with the DCBF servers is detected, the Operational DCBF

System can provide uninterrupted service to the users. Figure 2-9 shows one server for Web/application and database hosting, but the actual number depends on operational usage. The redundancy is within the DCBF system to provide services to the end users. The design allows scaling up to a Web farm configuration, application cluster, or database cluster to provide progressively higher system capability and to handle a larger request demand. The exact initial processor configurations needs be determined during system design.

Within the Production Facility segment, two firewalls create a security zone (a demilitarized zone or DMZ) around the equipment supplying Internet services (HTTP, e-mail, DNS). The database and application servers are behind the second firewall, which affords another layer of security, protecting key information. Redundant, high-availability servers are used to achieve greater than 99% system availability. Symmetric multiprocessors with addressing to large memory stores within the servers provide the hardware scaling needed to process hundreds of simultaneous users and thousands of transactions per day. All this hardware need not be purchased at the start of operation. It can be added incrementally as the loading increases.

This current project is an R&D proof-of-concept. The hardware selection and system design need to be executed under a procurement contract for the operational version of DCBF.

2.5 System Comparison

This study reviewed B.C.'s Lower Mainland border crossing as the focus for the DCBF concept. During this study the IRE, CDE, B.C. Solicitor General's National Safety Code (NSC) and Trade Corridor Operations System (TCOS) were reviewed and a comparison of these systems to DCBF capabilities was made. Each system requires protocols to be developed between each jurisdiction.

2.5.1 British Columbia Solicitor General's National Safety Database

The British Columbia Solicitor General (BC-SG) is responsible for National Safety Database (in B.C.) and subsequently performs the CVO communications to other jurisdictions via the IRE network, and exchanges accident, inspection, and contravention records with the CDE at the CCMTA. The IRE network is, in effect, a CVO e-mail system. With each jurisdictional request, a response is sent by the jurisdictional agency that the request was made to.

The BC-SG supports all authorized requests made to it on the IRE network.

The BC-SG performs the following CDE activities:

a. Extract and send data to CCMTA

b. Receive from the CCMTA rejection lists from other jurisdictions

c. Load inspection data from CCMTA into inspection tables

d. Load accident data from CCMTA into accident table

e. Load conviction data from CCMTA into contravention table

f. Load inspection, accident, and contravention data for other province/territories into BC-SG CDE database for transmission to CCMTA

2.5.2 Trade Corridor Operations System

TCOS has currently completed Phase 3 (Electronic Seals) of the International Mobility and Trade Corridor (IMTC) project. This project demonstrated the collection and management of CVO and container information from the border through weight scales, train stations, and ports (U.S. and international). This system collects data from a large number of national and international sources and collates the information and deliveries history and status information on vehicles, driver, routes, locations, and e-seal status. This project was a success in demonstrating the value of this information to the stakeholder in the project. Appendix C of this report presents an outline of TCOS and the type of information collected and exchanged in XML format.

2.5.3 Comparison

Table 2-1 gives a comparison of selected functions that the DCBF can support with TCOS and the BC-SG NSC system and continue to support the BC-SG NSC relationship CCMTA via the IRE network and the CDE system. A sample ingest of the WSDOT SAFER data (see Appendix E) was included in the demonstration. However, this data was not included in this comparison due to the range of information supported.

Table 2-1 System Comparisons

Feature	DCBF	IRE	CDE (BC-SG)	NSC	TCOS
Interface/date design	The system is designed to support any interface. The information is converted and can then be resent in XML format, or a local jurisdiction format	Format as per agreement between each jurisdiction	Items listed are as per NSC standard	National format defined. This column contains table names in that format	Fixed definition by the project, all parties use the same
Vehicle Location-GPS	√				√
Vehicle Location-Weight Scale	√		CDE – inspection record	CDIN	√
Cargo manifest	√				√
E-Seal	√				√
E-Seal stat	√				√
Route information	√				√
Store and forward	√	√			
Basic driver licence inquiry	√	√			
Driver name search	√	√			
Vehicle inquiry	√	√			
Vehicle (tractor) history	√				√
Vehicle (trailer) history	√				√
Container history	√				√
Driver profile inquiry	√	√	CDE – driver table	NSDR	√
Driver abstract inquiry	√	√	CDE – driver table	NSDR	√
Accident record	√		CDE – accident record	CDAC	
Inspection record	√		CDE – inspection record	CDIN	
Vehicle record	√	√	CDE – vehicle record	CDAC	√
NSC Contravention update history	√		CDE – NSC Contravention update history	NSUC	
NSC Accident update history	√		CDE – NSC Accident update history	NSUH	

3 APPLYING DCBF TO CVO IN B.C.

This section discusses how the DCBF concept, introduced in Section 2, can be applied to assist CVO (Commercial Vehicle Operations) in British Columbia. Section 2 was concerned with giving a general presentation of the DCBF that emphasizes the flexibility and generality of the concept.

The B.C. region is an excellent test bed for the DCBF concept because it has a sufficiently rich transportation infrastructure and a full array of stakeholders, while being a sufficiently small region to properly demonstrate the concept. The scale and time of the DCBF Concept project limit the amount of detail that could be covered in a national analysis. The focus on the B.C. Lower Mainland and the Pacific Highway crossing allows the concept to be demonstrated with multiple jurisdictional boundaries and intermodal transport methods. The DCBF uses a scalable system that allows for the DCBF to be deployed nationally with a single DCBF site or a number of DCBF sites (i.e., one for each province and territory) or a combination of deployments. The system may be deployed at a number of security levels with controls on the type of information being accessed between DCBF (immigration, etc.).

This section's discussion focuses on communicating an understanding of the applicability of the DCBF concept to B.C. This section does not attempt to be an exhaustive discussion of CVO stakeholders and the details of how they would use DCBF; rather it shows, with a few examples, how the general architecture can be elaborated for the B.C. region.

3.1 Network Initiatives

A network is required for DCBF users to interact with the DCBF. Currently there are a number of networks in place, both at the proprietary level and public level (e.g., Internet). The DCBF will be able to work with all the networks that have open standards (e.g., Internet, IRE, CDE). Because the nature of the DCBF is such that messages are defined from XML schema, then the information can be "dropped" or use air gap

technologies on very secure platforms via proprietary level networks (Solicitor General, Justices, etc.) without adding any direct access to the secure networks.

3.1.1 IRE and CDE Networks

The users of the DCBF need to have access to the Canadian CVO network. The Technical Feasibility Study [2] proposes essentially only two Canadian systems to support a CVO network. These are the IRE (Inter-provincial Record Exchange) system and the CDE (Carrier Data Exchange) system.

These systems are both operated by the CCMTA and, while ostensibly independent, are highly inter-related.

IRE and CDE are inter-related systems, so much so that the concept of the "IRE network" has become confused.[6] CDE is a newer system, but is also well received and well used. Primary users are Ontario, Quebec, B.C. and Alberta, with lesser usage in Manitoba and New Brunswick. Usage reflects the amount of inter-provincial traffic in the various jurisdictions. The primary drawback of the system is the time delay and hence the timeliness of the information. Each jurisdiction is currently free to transmit and receive information on each jurisdiction's schedule.

Both systems provide an excellent potential for use in a nation-wide CVO system. A lot of time and energy has been put into creating these systems and a lot of effort has been expended by the various jurisdictions in support of these systems.

The DCBF use of a national CVO network needs to be addressed in a future study on implementing the DCBF on a national system.

3.1.2 Internet

The DCBF supports Internet access to allow for small organizations to have economical access to the system from remote access points. There are a large number of operations currently supporting information dissemination via the Internet. The DCBF allows a number of access points to the Internet to enable a variety of users and applications to have access to authorized information. The IMTC TCOS system currently allows stakeholders (including WSDOT, CBSA, CBP, etc.) access to the system via the Internet.

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[6] See [2], Chapter 3.1.1, Current State of Canadian CVO Systems. The confusion between the two systems lies in the fact that the CDE network transactions can be exchanged on the IRE network.

3.1.3 Law Enforcement Information Portal (LEIP)

B.C. has created the Law Enforcement Information Portal (LEIP) to allow all police agencies in B.C. to communicate and share information. Police and Justice departments need access to monitor activities of CVO or containers. The information these organizations require may be contained within the DCBF. The difficulty in these organizations having direct access to these sites is the level of "trust" in the two environments. Modern methodology has allowed for the use of Air Gap technology. Air Gap technology is currently used by military and intelligence agencies where information has to be moved between trusted and untrusted networks. Air Gap serves a similar purpose to the firewall, as it creates an obstacle between a trusted and an untrusted network. The concept is, however, somewhat different. In the physical world, a firewall is a barrier between the fire and the safe area designed (but not guaranteed) to impede the passage of the fire. This is exactly how a computer firewall works. Air Gap does not place an obstacle between the two networks—it seeks to place a "gap" over which the "fire" cannot pass. In this sense, Air Gap technology would be better described as a "firebreak". The DCBF using Air Gap technology with LEIP could allow for rapid information dissemination between trusted and untrusted networks.

3.2 ITS B.C. Initiatives

Within the definitions of the British Columbia Intelligent Transportation System (B.C. ITS) Architecture, there are a number of initiatives that the DCBF satisfies.

3.2.1 Initiative No. 12 Safety & Legal Assurance Compliance Data Collection, Dissemination, & Sharing

The DCBF could be used to implement Initiative 12 by brokering the information collected and distributing it to the various jurisdictional systems, including transborder systems. By using the DCBF to broker the information, roadside or border systems can be notified in advance of vehicles that have caused a reaction by the DCBF rule processing.

The following is the description from B.C.'s ITS Provincial Plan [4] for Initiative No. 12, Safety and Legal Assurance Data Collection, Dissemination, and Sharing:

> *"This initiative will develop a program to facilitate the real-time collection, dissemination, and sharing of commercial vehicle safety and compliance information among jurisdictions at the provincial, national and international levels. This effort will focus on safety and compliance information for vehicles, drivers, and dangerous cargoes. This will include improving the capture of vehicle inspection information at the roadside weigh scales and/or inspection facilities and required upgrades to existing credentialing systems. The ability to*

exchange and share common safety and compliance information will facilitate a seamless system of mobility for compliant carriers, minimizing delays and congestion levels at checkpoints. This functionality will also provide benefits to ICBC's planned Carrier Incentive Program aimed at raising safety levels in the commercial transport industry. Moreover, the data systems should make real-time safety data available at roadside (fixed/portable facilities) for tactical and strategic compliance activities."

It will also facilitate the interchange of compatible data between regulatory jurisdictions. A critical component of this program is to develop a safety database/interface that enables the interchange of compatible information among jurisdictions across Canada and throughout the U.S.

3.2.2 Initiative No. 13 Roadside Electronic Screening

The DCBF could help facilitate this initiative by allowing brokering of information collected at various roadside data points to be distributed. The DCBF supports sharing of information between carriers and shippers on the status/location of vehicles. Although this initiative does not directly support the distribution of information outside the legal system, the information for the legal system can be brokered through the DCBF. The clearinghouse could be used to generate information on high-risk carriers by using rules supplied to monitor activities throughout the system.

The following is the description from B.C.'s ITS Provincial Plan [4] for Initiative No. 13, Roadside Electronic Screening:

"This initiative will deploy roadside electronic screening technology at strategic locations within the province (e.g., high volume, entry points, etc.). Automated Vehicle Identification (AVI) devices coupled with weigh-in-motion (WIM) capabilities will facilitate gains in compliance levels through the ability to target enforcement efforts at "high risk carriers", and increasing overall productivity at roadside weigh scales. Operating costs to carriers would be expected to decrease through reduced delays in transportation."

3.2.3 Initiative No. 14 Enhanced Border Clearance for Cargo & Vehicles

The DCBF would satisfy the concept of this initiative in conjunction with the IMTC TCOS Program. The DCBF has the capability of functioning as a mirror image to the TCOS program. This would allow the same two-way processing between the U.S. and Canada, exchanging information to track and pre-screen drivers, cargo, and vehicles bound for border and customs clearance. The DCBF could be used to expedite the transfer of information between the two nations, supporting the ITS initiatives of the U.S./Canada Smart Border Action Plan [5].

The following is the description from B.C.'s ITS Provincial Plan [4] for Initiative No. 14, Enhanced Border Clearance for Cargo & Vehicles:

> *"Expand the International Mobility and Trade Corridor Program to incorporate 2-way (north/south) multi-modal tracking and pre-screening of drivers, cargo, and vehicles bound for border and customs clearance. This is an application of electronic pre-screening and clearance directed towards increasing the efficiency of transportation across international border crossings, allowing interface with customs-related functions."*

3.2.4 Initiative No. 15 Intermodal Freight Management

The DCBF could be used to broker information on intermodal containers and freight shipments. These functions are now being demonstrated with the IMTC TCOS system, and portions of this functionality will be used in the DCBF demonstration.

The following is the description from B.C.'s ITS Provincial Plan [4] for Initiative No. 15, Intermodal Freight Management:

> *"This initiative will deploy the ability to track and monitor intermodal containers and intermodal freight shipments anywhere in the transportation system. Information is provided to freight customers, fleet managers, and logistics service providers to improve delivery of cargo. The system would allow for the monitoring of the container and its contents during the entire pickup-transport-drop-off period. The key capabilities include the ability to identify and control vehicle traffic entering and departing the intermodal facility, guide vehicles to loading and unloading points, maintain site security and monitor freight integrity, provide an interface to CCRA and USCS as appropriate, and acknowledge container pickup and drop-off. Other capabilities include the ability to track container locations within the facility and to manage any other required assets, like truck chassis."*

3.2.5 Initiative No. 17 Dangerous Goods Incident Response

Part of this initiative is to identify and allow for the registering of HAZMAT information. The DCBF could function as a broker and a clearinghouse for this information, ensuring the information is distributed to all the required agencies associated with monitoring HAZMAT or other dangerous goods movement throughout the province. All dangerous goods movement within the province would be required to register. This would involve the use of an AVI/AVL tag to assist in cargo identification and location, utilizing GPS technology. Implementation of this system would provide an incentive for transportation companies and other agencies involved in the shipping of commercial goods to implement a vehicle and goods tracking system.

The following is the description from B.C.'s ITS Provincial Plan [4] for Initiative No. 17, Dangerous Goods Incident Response:

> *"This initiative will deploy a program to monitor the movement of dangerous goods through the regional transportation network (road, rail and marine) and to respond to incidents."*

3.2.6 Initiative No. 18 Information Warehousing

Although the DCBF has a rule management for crash information and the background information required to perform these activities, the DCBF functionality could be replicated for this B.C. ITS function, the whole focus being that the rules and brokerage information can be tied into the crash database.

The following is the description from B.C.'s ITS Provincial Plan [4] for Initiative No. 18, Information Warehousing:

> *"This initiative will develop and implement a regional data management program to support collection, processing, access, storage, and retrieval of data. In addition, this initiative will establish a central provincial crash database integrating crash data from police, highways, and municipal agencies. This will include developing standards and interfaces to allow access by multiple agencies and levels of government."*

4 DCBF DEMONSTRATION

This section describes the system created to demonstrate the DCBF concept. The focus was on the following four capabilities (see Figure 4-1, Section 4.6):

1. Pushing data into the DCBF server
2. Triggering output
3. Querying the DCBF server
4. Rule modification

4.1 Data Model for the Demonstration System

Table 4-1 describes some of the input sources from which DCBF receives its data. Note that there are two types of data. The first data type is static and is stored in the database from the beginning. The second data type is dynamic data, which is pushed to the DCBF server over time. There is one table for each of the data source rows in the database.

Table 4-1 Data Model Sources

Source	Type	Data Items
Solicitor General & TCOS	Static	Driver ID
		Vehicle ID
Solicitor General & TCOS	Dynamic	Timestamp
		E-Seal Stat
		Truck Location
DCBF		Off Route (Y/N)
Trucking Company and/or Broker	Static	E-Seal
		Destination
		Cargo ID
		Cargo Manifest
		Carrier ID
		Container Gross Weight
BCMOT & WSDOT	Static	Vehicle ID
		Vehicle Class
		Max Weight Limit
		Driver ID
		Driver Name
		Carrier ID
Trucking Company A	Dynamic	Driver ID
		Carrier ID
		Vehicle ID
		Cargo ID
		Cargo Manifest
		Truck Route
		Truck Schedule
		Timestamp

4.2 Pushing Data Into the DCBF Server

In the demo system, one system was set up to transfer useful information to the server. The messages were XML-based, the industry standard interchange method. For the demo, a simple XML schema was created as a basis. Obviously, in an operational system, the schema would be more comprehensive but still would have to be accepted by all participating systems. Also, in a real setting there is more than one system that communicates with the server.

The DCBF concept has the DCBF server receiving XML messages, and in turn parsing and retrieving the tags and storing them in a relational database. Later on, when the system forms a response to a query, it pulls data out of the database.

4.3 Triggered Output

In the demo system, each rule had one or more associated users who were notified whenever that rule was violated following receipt of dynamic data from the data sources. The notification will be via e-mail to a specified e-mail address. In a more advanced system, other messaging mechanisms can be deployed that will send messages to systems rather than user e-mails. An example of such a system could be JMS (Java Messaging Service).

4.4 Querying the DCBF Server

The demo system provided a mechanism to handle a specified set of queries. For example, a user may be interested in information about a particular truck such as its current status, its history and owner's information. Depending on the user's privileges, different sets of queries were available to the user to choose from. For the demo, an interface was developed that provided a menu of query items from which the user could select. In this way, the formation of the query was restricted by the system based on the user's access privileges.

Submitting a query happens as a result of a user receiving a rule violation notification. In that case, the user would want to examine the context in which the rule has been violated. For example, when a notification of "off route truck" is received, the user may wish to get detailed information regarding the current route of the truck, which requires querying the DCBF server.

Table 4-2 lists a set of queries supported by the demo system. It also shows which user(s) can submit each query and which data items are available to that user as a result of the query. To serve these queries, a combination of the database tables is queried. This demonstrates the clearinghouse capability of the proposed DCBF concept.

Table 4-2 Data Model Queries

Query ID	Query Input	Authorized Users	Output Fields
Q1	Vehicle ID	Solicitor General, TCOS, CBSA, CBP	• Current route history • Driver Name • Carrier Name • E-Seals
		Trucking Company A	None if not the owner, otherwise all the above fields.
Q2	Driver ID	Solicitor General, TCOS, CBSA, CBP	• Current Route History • Carrier ID
		Trucking Company A	None if the driver does not work for the company.
Q3	Cargo ID	Solicitor General, TCOS, CBSA, CBP	• Cargo Manifest • Cargo History • Cargo Route (Truck Route) • E-Seal
		Trucking Company A	None if not the owner of the vehicle carrying the cargo.

In a future more advanced system, the server would support web services queries, which are SOAP-based and are submitted by systems rather than users.

4.5 Rule Mapping

In the demo system, a mapping between users and rules was developed. This mapping was accomplished by editing an XML file that contained the rules and users. This capability was provided on the server, which means an administration user could perform this task by working on the server and not remotely. In an operational setting, this capability, as well as building and modifying the rules, will be available to authorized users through a medium such as the Internet, and the rules will be stored in a rule-based database. An inference engine would be used to serve queries and fire triggers.

Table 4-3 provides a rule legend and Table 4-4 is a list of rules and notified users to be implemented for the demonstration system.

Table 4-3 Rule Legend

Stakeholder	Description	Acronym
Solicitor General		SG
Canada Border Services Agency		CBSA
Transport Canada		TC
Trucking Company A	Generic Trucking Company	TCA
Jane Doe Brokers	Generic Broker Company	JDB
U.S. Customs and Border Protection		CBP
Trade Corridor Operation System	Container and truck tracking	TCOS

Table 4-4 Demonstration Rules

Stakeholder	Collection Point	Information	Rule	Distribution	Perceived Benefit
SG	Weight Scale	Truck Location	Compare to previous location	Speed Violation for Load (e.g., if vehicle is 86,000 kg, max speed on road is 70 km/h) Vehicle average speed was 80 km/h then violation occurred	Excess wear and tear on the road is avoided. Excessive speed is reduced.
SG	Weight Scale	Truck Route	Vehicle is not en route	TCA notified, DCBF record of deviation saved	TCA is notified of deviation, deviation normally will cost time, wear and tear on vehicle, product ageing (in agriculture products, etc.).
SG	Weight Scale	Driver ID	Driver has changed	TCA notified, CBP notified	TCA needs to know who is driving its vehicle. CBP needs to know.
SG	Weight Scale	Cargo (manifest)	Cargo not valid (e.g., was a container, now a trailer)	TCA notified, CBP notified	TCA needs to know of change, CBP needs to know that the expected carrier configuration has changed.
SG	Weight Scale	E-Seal (yes/no)	E-Seal broken	TCA notified, CBP notified	Security issue TCA and CBP need to know.
TCOS	Database	Truck Route	Vehicle is not en route	TCA notified, DCBF record of deviation saved	TCA is notified of deviation, deviation normally will cost time, wear and tear on vehicle, product ageing (in agriculture products, etc.).
TCOS	Database	Driver ID	Driver has changed	TCA notified, CBSA notified	TCA needs to know who is driving its vehicle. CBSA needs to know.

Stakeholder	Collection Point	Information	Rule	Distribution	Perceived Benefit
TCOS	Database	Cargo (manifest)	Cargo not valid (e.g., was a container, now a trailer)	TCA notified, CBSA notified	TCA needs to know of change, CBSA needs to know that the expected carrier configuration has changed.
TCOS	Database	E-Seal (yes/no)	E-Seal broken	TCA notified, CBSA notified	Security issue TCA and CBSA need to know.
TCOS/CBSA	AVI and/or vehicle identification system (see Hwy 407 ETR Ontario) (at Border arrival AVI's Border Line-up, Inspection booth, Secondary lock-up entry point, and border release point)	Passing Point	Frequency	TCA notified, CBSA notified	TCA can know how long its vehicle is in border activity. Liability and issues on product ageing can be managed by both TCA and CBSA/CBP better. Vehicle border activity and history can be maintained and supplied (frequency of vehicle, tractor, trailer passing through, and discrepancies [i.e., same trailer is passing through the border a number of times but with different tractors]).

4.6 Demonstration Environment

The demo was built using two PC workstations, with one workstation representing the DCBF server and the other workstation representing an external computer. The latter workstation also acted as the system that pushed data to the server. As mentioned in Section 4.5, modifying the rules was done manually on the server.

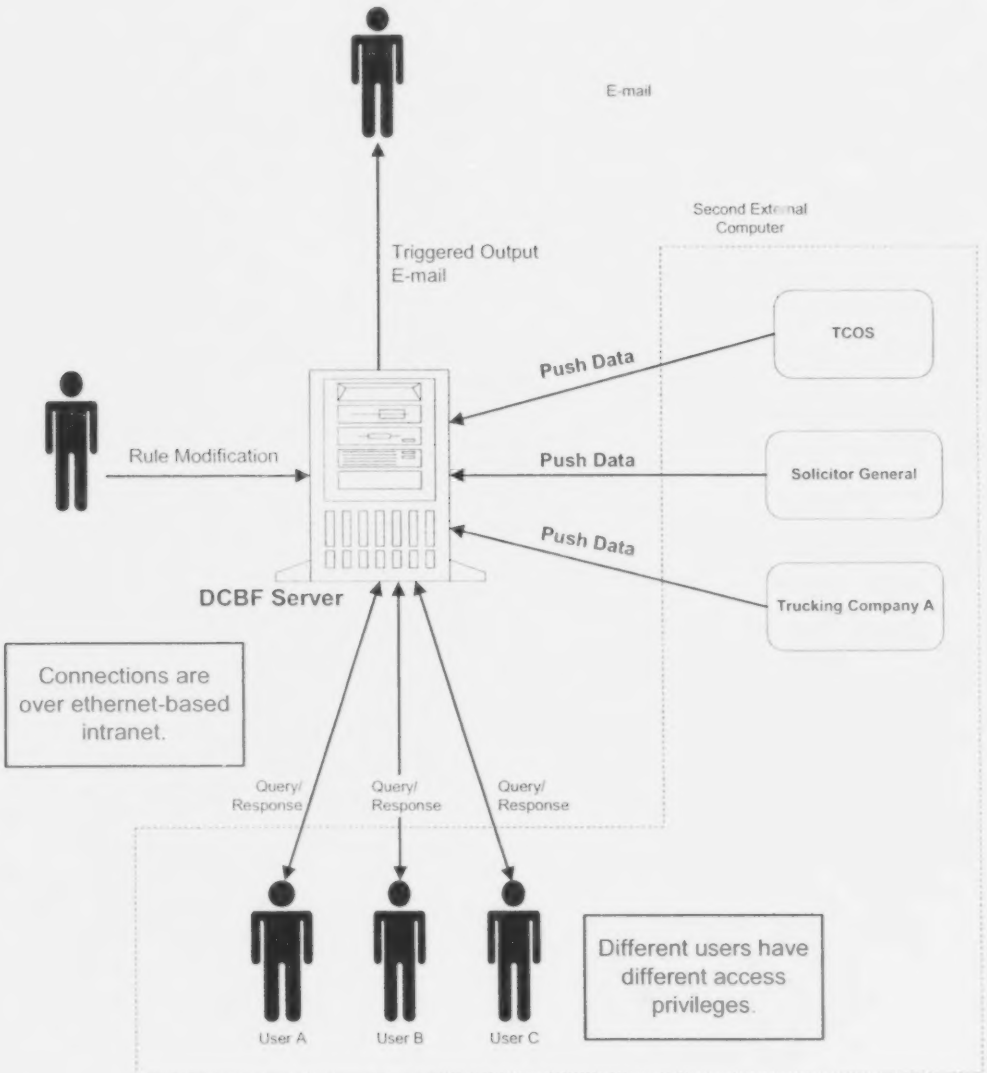

Figure 4-1 Logical Connection

The system was implemented in an intranet, rather than an Internet setting. However, in an operational setting, most of the capabilities should be implemented so that remote users who are not on the intranet are able to interact with the system.

Figure 4-2 shows a conceptual layout of the demonstration.

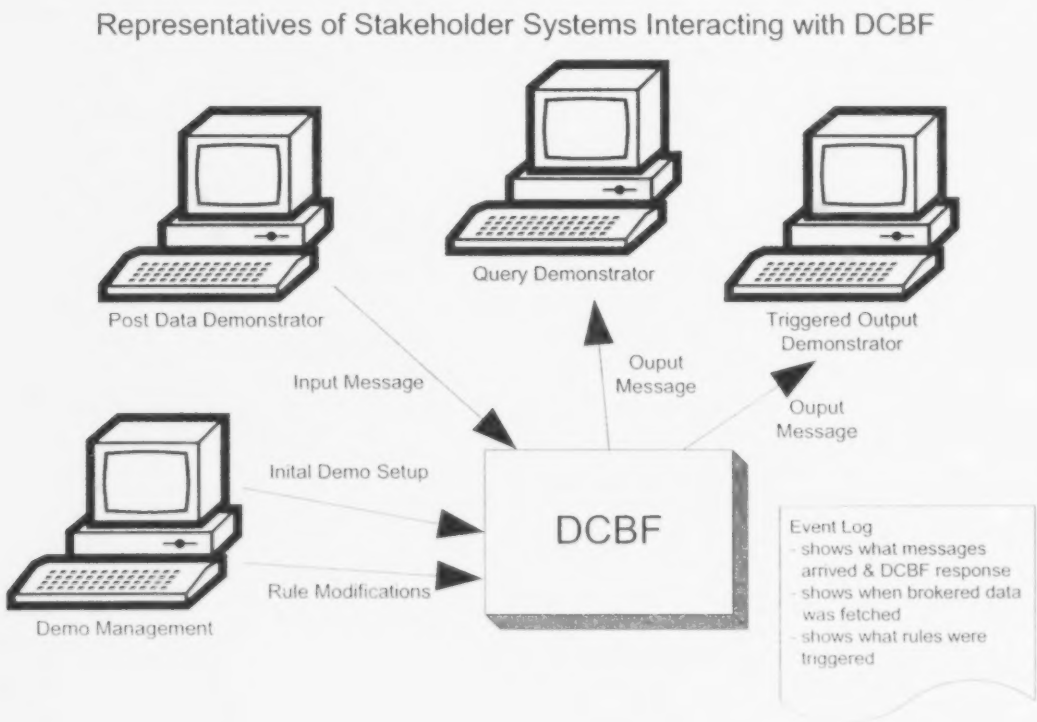

Figure 4-2 Test Configuration

The **Demo Management** workstation was responsible for loading and starting the demonstration. During the demonstration, current rules were edited to show how the system's behaviour is effectively controlled through a rule base.

The **Event Log** provided a detailed listing of all events within the DCBF to identify major events in processing that message so that viewers of the demonstration could understand how the system behaved.

The **Post Data Demonstrator** workstation represented a stakeholder where new data was created and posted to the DCBF. The Event Log was able to show the XML message received by the DCBF.

The **Query Demonstrator** workstation represented a stakeholder who requested information from the DCBF. The Event Log was able to show the receipt of the XML query message and the XML response.

The **Triggered Output Demonstrator** workstation was used to show examples of messages triggered by a rule within the DCBF.

Please note: The figure shows "workstations" and the above descriptions use the term "workstation", but these were, in fact, implemented as windows that interact with the DCBF demonstration system.

4.7 Framework Design

Figure 4-3 contains the design diagram and list of tasks for the DCBF demo. A number of technologies were used in the demo design, which could also be used in a real operational system. The demo was built on J2EE platform. All the data was stored in an RDBMS (SQL Server in this case). All the communication between components was based on XML, which is the standard for data representation as well as data sharing.

The business logic was implemented as servlets on both the server side and client side. The data provider servlet sends XML messages to the DCBF server. These messages include transportation information. The information, while received on the server, is stored on the database and is also fed into the rule engine for validation. Any invalid transaction triggers an alert, which is in the form of an e-mail sent to the appropriate party. Then the party can use the query program to access more detailed information regarding a particular transaction.

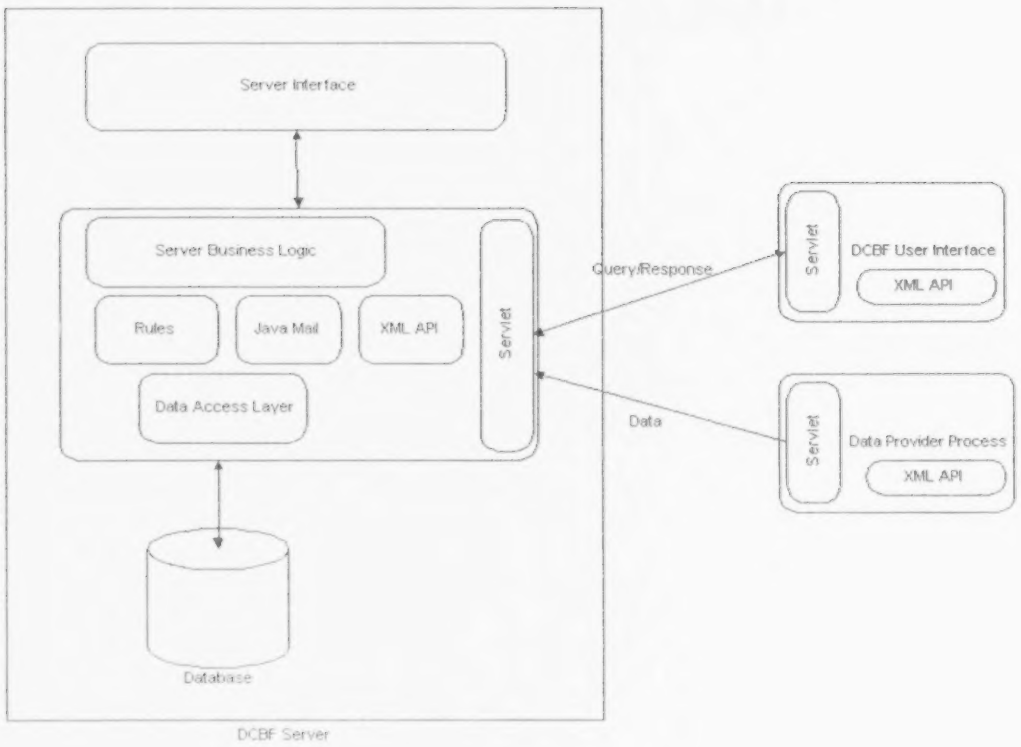

Figure 4-3 Framework Design

4.8 Environment Setup

The demonstration was set up to demonstrate the DCBF concept using creating rules and data that could reflect operational values.

A database was created and populated with imaginary data to be used by the demonstration. The following tables where created:

- User table
- Trucking company
- Solicitor General and TCOS
- BCMOT and WSDOT (static data)

The Data Access Layer was developed to allow for SQL update, insert, and select modules and the support of the rules. This layer included an XML parsing module and a Simple Rule Engine.

A Server Interface window was created to allow the administrator to view the following:

- Incoming messages
- Rule validation
- Outgoing notifications

A servlet was created for the data sources (e.g., TCOS) for sending out streams of hard-coded messages to the server.

A Client User Interface was created to allow for the following:

- Interface for forming and submitting queries
- Message composition (XML marshalling)
- User login and authentication (could be a server module)

For the demo, the software package created 16 Java Classes to perform the functions required to demonstrate the concept. Table 4-5 shows the Java Classes and their functionality.

Table 4-5 DCBF Demo Java Classes

	Class Name	Class functionality
Client Package	DCBFClient	A standalone program that implements the data providers' components, e.g., Truck Company A (TCA).
	QueryClient	A standalone program that implements the end user Query capability. It implements both the presentation logic (GUI) and the business logic (user can login and view information).
	SAFERXML	A sub class that encapsulates hard-coded SAFER messages to be sent to the server (server only confirms the receipt of the message with no further processing).
Server Package	Alert	Implements an Alert Object. Each Alert object is a representation of an Alert record in the database.
	CarrierMessage	Implements a Carrier Message Object. Each Carrier Message object is a representation of a record in the Carrier table. It is a child class of DCBFMessage class.
	DBSession	Implements the Data Access Layer (DB read and write).
	DCBFMessage	Implements the general DCBF message class (children classes are CarrierMessage and SGTCOSMessage).
	DCBFRuleEngine	Implements the rule uploading at the start up and also rule validation after receiving each message.
	DCBFServer	Implements the server application logic (fetching messages from the servlet, parsing XML content, rule validation, and DB update). This is by far the largest class that encapsulates the core functionality of DCBF server.
	E-mail Notification	Implements the e-mail capability. (When there is an alert message, an e-mail goes out to the proper recipient.)
	RulesContainer	Implements the rules used by the Rule Engine class. The rules themselves are stored in XML in a separate file. At the system start up, the server ingests the rules into the system by adding objects to "RulesContainer" class.
	ServerServlet	Implements the servlet, which receives XML, messages from the data providers (DCBF Client program). This class is deployed within the Servlet Container context (in this case Tomcat).
	SpeedRules	Implements the application logic governing the speed-related rules.
	StaticData	Implements the objects that represent the static data in the system. These data are the ones that do not change frequently (e.g., BCMOT data).
	SGTCOSMessage	Implements a SG-TCOS message object. Each of these objects represents a record in the sg_tcos table.
	Utils	Implements miscellaneous functionalities that are commonly used.

5 BENEFITS

As identified in Section 3, the purpose of implementing a DCBF is primarily for the benefit of efficiency and security gains for the Canada Border Services Agency and its various stakeholders and clients. The DCBF solution provides for efficient movement of goods across the Canada-U.S. border through the use of standardized and automated data exchange. This results in the reduction of time, and therefore costs, required to pass through the border inspection services. The DCBF's standardized data exchange also allows for the provision of a fast and secure rules-based exchange of data. With the expedited movement of trucks across the border, additional benefits in the form of reduced emissions and fuel consumption, and other benefits, can be realized. These benefits formed the basis of the evaluation framework that was applied to estimate the potential benefits of a DCBF implementation of varying degree.

The evaluation framework for the assessment of benefits is shown in Table 5-1. The benefits within the framework are categorized in the four areas of Efficiency, Security, Emissions and Energy, and Other Benefits. Indicators or measures of effectiveness (MOEs) that describe the extent of the benefits for each category are also shown in Table 5-1.

In order to evaluate the conceptual DCBF, a total of ten scenarios were developed with varying degrees of agency/stakeholder participation (in the form of access to database information) and industry participation (in the form of transponder utilization). The first scenario, Scenario 1, is the base or "do-nothing" scenario that acts as the datum or reference for the evaluation.

Table 5-1 Evaluation Framework

DCBF Goal Area	Expected Impacts	MOE	Estimation
Efficiency	• Time savings, improved resource utilization, and improved targeting of commercial vehicle inspections due to real-time access to timely and accurate data for targeting high-risk carriers • Pre-arrival information results in faster processing time for participating commercial vehicles and direct release of participating commercial vehicles from primary line • More pre-screening of commercial vehicles for violations	• Total time in system • Delays in the queue waiting for and performing primary inspection • Number of vehicles in queue for primary inspection	Simulation
Security	Improved security results from better targeting of commercial vehicle inspections due to: • Real-time access to timely and accurate data for targeting high-risk carriers • More pre-screening of commercial vehicles for violations • Enhanced compliance	• Increased number of potential violations identified	Application of DCBF rules in simulation
Energy and Environment	Fuel savings and fewer emissions as more commercial vehicles will be released directly from primary line that results in: • Less idling of diesel engines at inspection stations, reduced energy use from reduced accelerations and less wear and tear of brakes and other associated motor vehicle components due to less need for stopping and queuing for inspection	• Fuel consumption • Vehicle emissions	Using the results of simulation and available literature
Other Benefits	Cost reduction, revenue, economic benefits, and customer satisfaction: • Increased revenue from taxes due to monitoring activities • Increased trade flows • DCBF customers value the incremental benefits they experience more highly than the incremental costs they bear		Beyond the scope of this study

Figure 5-1 shows the ten scenarios in their relation to agency and industry participation rates, where:

- Scenario 1 represents a base scenario of no transponder-equipped vehicles and no DCBF implementation.
- Scenarios 2 to 4 represent scenarios with a DCBF implementation with only driver information provided (check for correct driver), and 10%, 50%, and 100% of commercial vehicles equipped with a transponder, respectively.
- Scenarios 5 to 7 represent scenarios with a DCBF implementation with driver, E-Seal status, and cargo-ID information provided, and 10%, 50%, and 100% of commercial vehicles equipped with a transponder, respectively.
- Scenarios 8 to 10 represent scenarios with a DCBF implementation with driver, E-Seal status, cargo-ID, and schedule (ETA check) information provided, and 10%, 50%, and 100% of commercial vehicles equipped with a transponder, respectively.

The scenarios are numbered such that they generally increase with increasing DCBF implementation, which is in the form of agency and industry participation.

These scenarios are not real; however, they have been developed assuming hypothetical participation levels of a DCBF implementation. Their value is in playing the role of incrementally changing "test" environments that will provide indications as to how each of the MOEs in the evaluation framework will perform.

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
	Low		Sc.2	Sc.3	Sc.4
	Med		Sc.5	Sc.6	Sc.7
	High		Sc.8	Sc.9	Sc.10

Figure 5-1 Evaluation Scenarios in Relation to Agency and Industry Participation

A discrete-event simulation model was developed representing a hypothetical form of the Pacific Highway crossing, at the national border between British Columbia and Washington State, with a general geometry that resembles the planned expansion[7] of the

[7] The basic geometry consists of truck traffic lanes separating from general traffic 250 m prior to the border inspection facility with two truck lanes (one for FAST and one for general trucks) approaching into three Primary Inspection Lanes (one FAST, two manned booths) as per discussions with CBSA officers.

Figure 5-1 shows the ten scenarios in their relation to agency and industry participation rates, where:

- Scenario 1 represents a base scenario of no transponder-equipped vehicles and no DCBF implementation.
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Agency Participation	Base	Sc.1			
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	High		Sc.8	Sc.9	Sc.10

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approach lanes in the near future. The evaluation focused on the northbound traffic, as these results will show the most benefits to the CBSA and its associated stakeholders. As the evaluation of benefits is based on simulated estimates of a number of hypothetical scenarios (including border inspection operations), it is not the intent, nor within the scope of this research, to provide accurate (e.g., real) results. However, given the wide range of scenarios developed, the simulation model and associated experimental design should be sufficient to adequately demonstrate the effectiveness of a potential DCBF implementation at the border crossing. The modelling information used to support the benefits is outlined in Appendix D.

For each of the 10 scenarios, 20 24-hour period simulation runs were made, each consisting of different "random seeds" to simulate 20 different days of a specific day of the week (e.g., Friday). This essentially provides 20 daily samples for each scenario, or 200 simulation runs in total, allowing for estimates that are of greater precision. Appendix D provides further details regarding the inputs and assumptions that were developed in the simulation model runs.

5.1 Efficiency Benefits

Efficiency in terms of commercial vehicle border crossing can be best measured in terms of time savings. The DCBF allows for the pre-screening of information, which results in faster processing time for participating commercial vehicles. As for the actual MOEs that quantify the efficiency benefit of DCBF implementation, they are as follows:

- Average total time in system per truck (minutes)
- Average total delay time per truck (minutes)
- Average primary inspection service time
- Average and maximum number of trucks in queue per lane

The resulting outputs of the simulation model runs were summarized for these MOEs and are presented in sub-sections 5.1.1 to 5.1.4.

5.1.1 Average Total System Time Per Truck

Table 5-2 and Figure 5-2 summarize the average total time for commercial vehicles to pass through the border primary inspection facility. This time includes travel to the border inspection booths from the I-5 freeway, time in queues, and primary inspection service time. This time does not include secondary inspection times, which are beyond the scope of this project.

Table 5-2 Average Total System Time Per Truck by Scenario, Minutes

Agency Participation	Industry Participation: Base	10%	50%	100%
Base	Sc.1			
	5.5			
Low		Sc.2	Sc.3	Sc.4
		4.7	3.5	2.7
Med		Sc.5	Sc.6	Sc.7
		4.2	2.5	1.7
High		Sc.8	Sc.9	Sc.10
		4.0	2.2	1.5

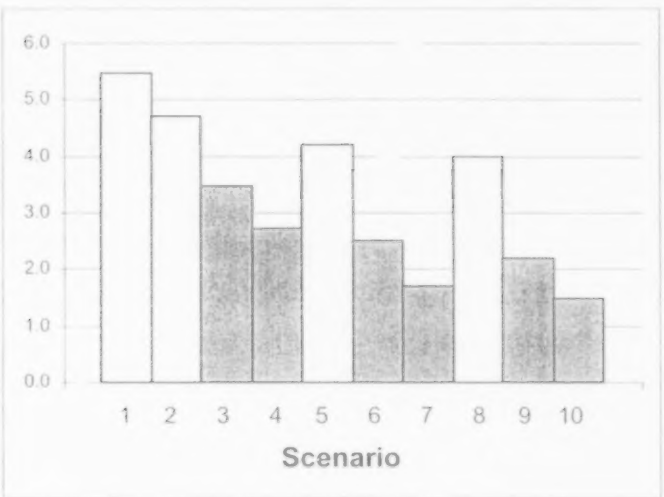

Figure 5-2 Average Total System Time Per Truck by Scenario, Minutes

The longest average time was estimated to be in Scenario 1 at approximately 5.5 minutes. For each of the DCBF implementation scenarios, a pattern is noticeable, which shows the average total time decreasing as both the agency participation and industry participation goes up. However, the rate of decline is more sensitive to the industry participation rate, with commercial vehicle utilization of transponders at levels of 50% to 100% showing substantially larger decreases in total times. Similarly, the additional gain in time savings tends to decrease from medium to high agency participation, irrespective of industry participation rate.

The fastest average times, of below 2 minutes, were estimated for Scenarios 7 and 10. Both consist of 100% industry participation.

5.1.2 Average Total Delay Time Per Truck

The total system time per truck has within it the time component to physically cross the border facility. This time is consistent for all vehicles; however, the delay experienced by each vehicle varies as a function of demand to use the border crossing facility.

Table 5-3 and Figure 5-3 summarize the average delay time experienced by truck for each of the 10 scenarios. Delay in this case is defined as the delay imposed onto a particular vehicle by the presence of other vehicles ahead if it (i.e., queues) plus the time for primary inspection service.

Table 5-3 Average Total Delay Time Per Truck by Scenario, Minutes

Agency Participation	Industry Participation: Base	10%	50%	100%
Base	Sc.1			
	4.9			
Low		Sc.2	Sc.3	Sc.4
		4.1	2.9	2.1
Med		Sc.5	Sc.6	Sc.7
		3.6	1.9	1.1
High		Sc.8	Sc.9	Sc.10
		3.4	1.6	0.9

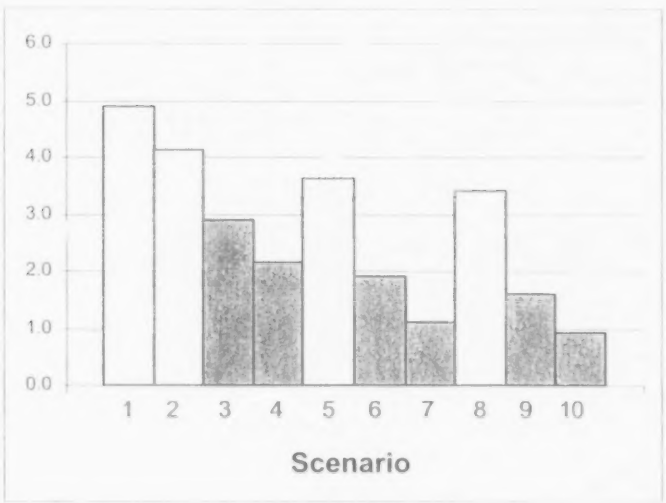

Figure 5-3 Average Total Delay Time Per Truck by Scenario, Minutes

Table 5-2 Average Total System Time Per Truck by Scenario, Minutes

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		5.5			
	Low		Sc.2	Sc.3	Sc.4
			4.7	3.5	2.7
	Med		Sc.5	Sc.6	Sc.7
			4.2	2.5	1.7
	High		Sc.8	Sc.9	Sc.10
			4.0	2.2	1.5

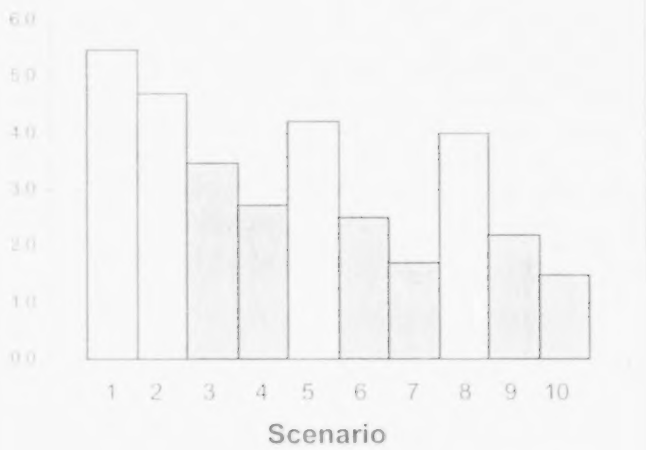

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Table 5-3 Average Total Delay Time Per Truck by Scenario, Minutes

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		4.9			
	Low		Sc.2	Sc.3	Sc.4
			4.1	2.9	2.1
	Med		Sc.5	Sc.6	Sc.7
			3.6	1.9	1.1
	High		Sc.8	Sc.9	Sc.10
			3.4	1.6	0.9

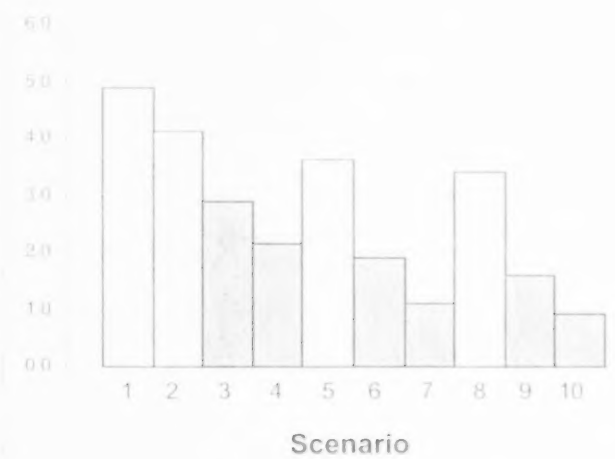

Figure 5-3 Average Total Delay Time Per Truck by Scenario, Minutes

Figure 5-3 demonstrates the profile of average total delay time per truck being similar to that of the average total system time per truck, although with lower times. This is to be expected, as the difference between the two measures is the non-stop travel time through the border crossing. Again, Scenarios 7 and 10 resulted in the lowest average delay times at 1.1 and 0.9 minutes, respectively.

5.1.3 Average Primary Inspection Service Time

Average primary inspection service times varied from approximately 70 seconds for the Base Scenario, to a low of 44.3 seconds for Scenario 10 (high agency participation and 100% industry participation), as shown in Table 5-4 and Figure 5-4. While the service times dropped as industry and agency participation rates went up, the decrease was more gradual for Scenarios 2, 5, and 8, which all have 10% industry participation. The trend of faster rates of decrease again appeared the most evident for the scenarios with 100% industry participation.

Table 5-4 Average Primary Inspection Service Time Per Truck by Scenario, Seconds

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		69.6			
	Low		Sc.2	Sc.3	Sc.4
			68.9	65.3	61.0
	Med		Sc.5	Sc.6	Sc.7
			67.8	59.7	49.7
	High		Sc.8	Sc.9	Sc.10
			67.3	56.8	44.3

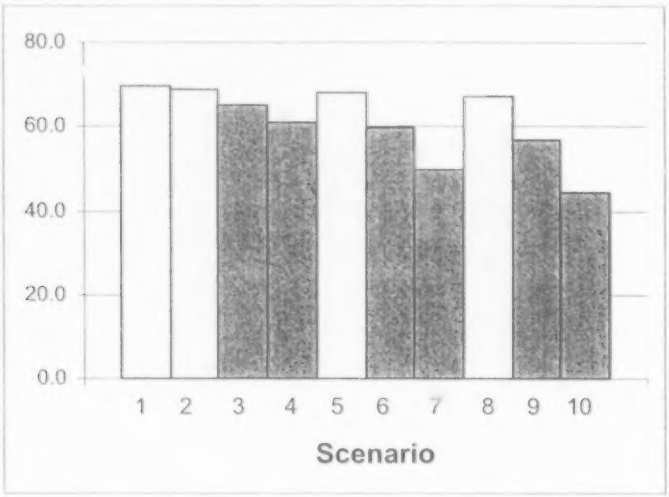

Figure 5-4 Average Primary Inspection Service Time Per Truck by Scenario, Seconds

5.1.4 Average and Maximum Queue Per Lane

As the average delay time decreased with an increase in agency and industry participation, it is expected that the average and maximum queue per lane will follow the same pattern. Tables and Figures 5-5 and 5-6 illustrate this to be true with queues decreasing as industry and agency participation increases.

Average queues range from a high of 4.5 trucks for the Base Scenario to 1.5 and 1.4 for Scenarios 7 and 10 respectively. The significance of industry participation is illustrated in both Figures 5-5 and 5-6, which show a slow decline of queue lengths in scenarios with lower industry participation (i.e., 10%) than ones with higher participation rates (i.e., 100%).

Table 5-5 Average Queue Per Lane, Trucks

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		4.5			
	Low		Sc.2	Sc.3	Sc.4
			3.8	2.9	2.3
	Med		Sc.5	Sc.6	Sc.7
			3.5	2.1	1.5
	High		Sc.8	Sc.9	Sc.10
			3.3	1.9	1.4

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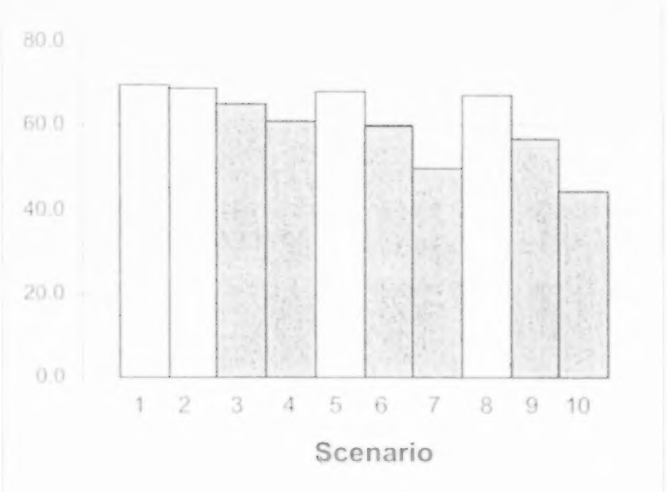
Table 5-4 Average Primary Inspection Service Time Per Truck by Scenario, Seconds

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		69.6			
	Low		Sc.2	Sc.3	Sc.4
			68.9	65.3	61.0
	Med		Sc.5	Sc.6	Sc.7
			67.8	59.7	49.7
	High		Sc.8	Sc.9	Sc.10
			67.3	56.8	44.3



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		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		4.5			
	Low		Sc.2	Sc.3	Sc.4
			3.8	2.9	2.3
	Med		Sc.5	Sc.6	Sc.7
			3.5	2.1	1.5
	High		Sc.8	Sc.9	Sc.10
			3.3	1.9	1.4

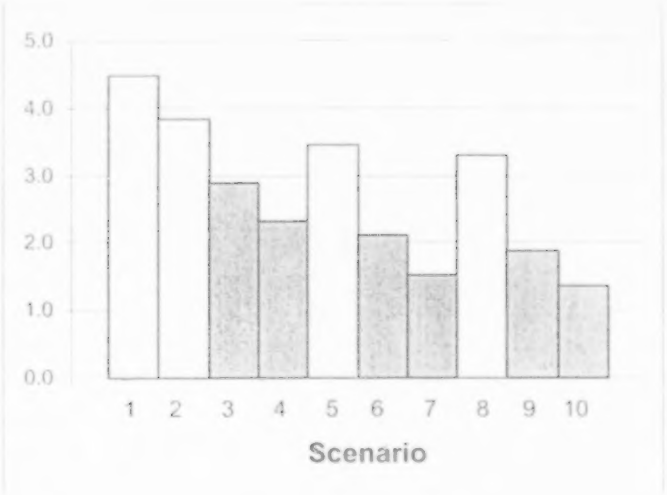

Figure 5-5 Average Queue Per Lane, Trucks

The maximum queue measure illustrates the significant effects of greater delays, with the Base Scenario having a maximum queue of 21.4 trucks, whereas half of the scenarios with high industry or agency participation rates (i.e., Scenarios 4, 6, 7, 9 and 10) have maximum queues that are one half to one quarter of the Base Scenario. This is a key indicator when planning for infrastructure requirements and it demonstrates that presumed cost savings in reduced inspection service can end up costing more in terms of future infrastructure requirements.

Table 5-6 Maximum Queue Per Lane, Trucks

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		21.4			
	Low		Sc.2	Sc.3	Sc.4
			19.3	14.7	11.6
	Med		Sc.5	Sc.6	Sc.7
			17.2	10.1	5.7
	High		Sc.8	Sc.9	Sc.10
			17.1	8.8	4.8

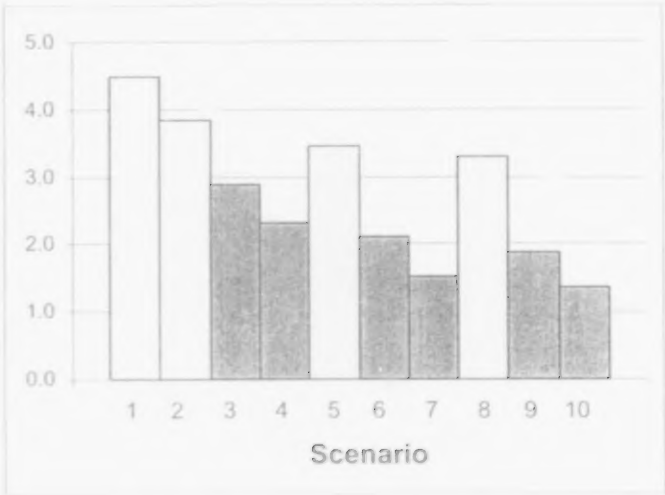

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Table 5-6 Maximum Queue Per Lane, Trucks

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		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		21.4			
	Low		Sc.2	Sc.3	Sc.4
			19.3	14.7	11.6
	Med		Sc.5	Sc.6	Sc.7
			17.2	10.1	5.7
	High		Sc.8	Sc.9	Sc.10
			17.1	8.8	4.8

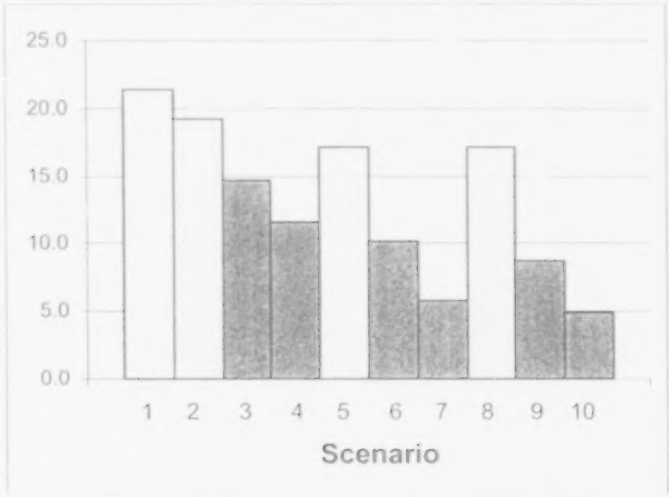

Figure 5-6 Maximum Queue Per Lane, Trucks

5.2 Security Benefit

Secure trade is of paramount importance to both Canadian and U.S. trading partners. The primary reason for the existence of the border inspection facility is to ensure safe and secure movement of goods in commercial vehicles. The use of technologies such as pre-screening and DCBF allows for the timely acquisition of vital information regarding the goods, carrier, and driver of a commercial vehicle. This results in a more thorough and automated inspection process that can increase the identification of potential violations while expediting the throughput of goods across the border.

A measure of effectiveness to quantify the security benefit of DCBF implementation was considered. However, it was decided that the measure would be highly subject to the assumptions made within the model. These assumptions were made in the simulation model as, understandably for the purposes of national security, no information regarding the effectiveness of the primary inspection service was provided.

5.3 Energy and Environment Benefits

Decreased delay for commercial vehicles at the border crossing results not only in time saving benefits for carriers and their cargo, but also in reduced energy consumption and air emissions. In addition, reduced delay results in less mechanical wear and tear of vehicle components such as brakes, transmission, and other associated mechanical components. Less wear and tear results in less particulate matter entering the environment, thus mitigating the impact on water bodies and local streams.

For the purpose of estimating energy and environment benefits as a result of a DCBF implementation, two measures of effectiveness were used:

- Average fuel consumption per truck (millilitres), and
- Average CO_2 emission per truck (grams).

5.3.1 Fuel Consumption

Average fuel consumption due to delay is estimated to drop dramatically from the Base Scenario, in which an average of 253 mL of diesel fuel is used per truck to pass through the primary inspection service, to an average of 47 mL per truck when there is 100% industry participation and high agency participation in the DCBF initiative (Table 5-7).

Table 5-7 Average Diesel Fuel Consumption Per Truck, Millilitres

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		253			
	Low		Sc.2	Sc.3	Sc.4
			213	149	111
	Med		Sc.5	Sc.6	Sc.7
			187	99	58
	High		Sc.8	Sc.9	Sc.10
			177	83	47

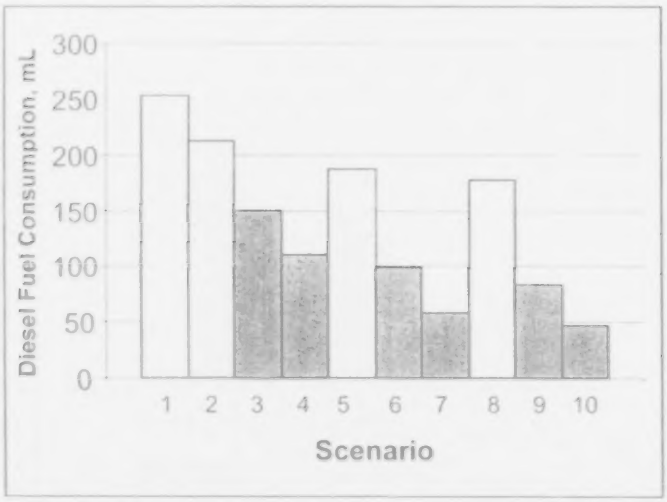

Figure 5-7 Average Diesel Fuel Consumption Per Truck, Millilitres

Figure 5-7 shows a similar pattern to the decreasing average fuel consumption with respect to increased agency and industry participation as with the other measures of effectiveness discussed previously. Again, the sensitivity towards industry participation (utilization of transponders) is greater than that of increased agency participation.

5.3.2 CO_2 Air Emissions

As CO_2 emissions rates of vehicles are proportional to the amount of fuel consumed, a similar pattern of decreasing CO_2 emissions is also estimated as agency and industry participation increases.

As shown in Table 5-8 and Figure 5-8, from a high of 669 grams of CO_2 emitted by the average commercial vehicle in the Base Scenario as a result of delay, the average CO_2 emissions drop down to a low of 126 grams per vehicle for Scenario 10.

Table 5-8 Average CO_2 Emissions Per Truck, Grams

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		669			
	Low		Sc.2	Sc.3	Sc.4
			564	396	293
	Med		Sc.5	Sc.6	Sc.7
			496	262	153
	High		Sc.8	Sc.9	Sc.10
			468	221	126

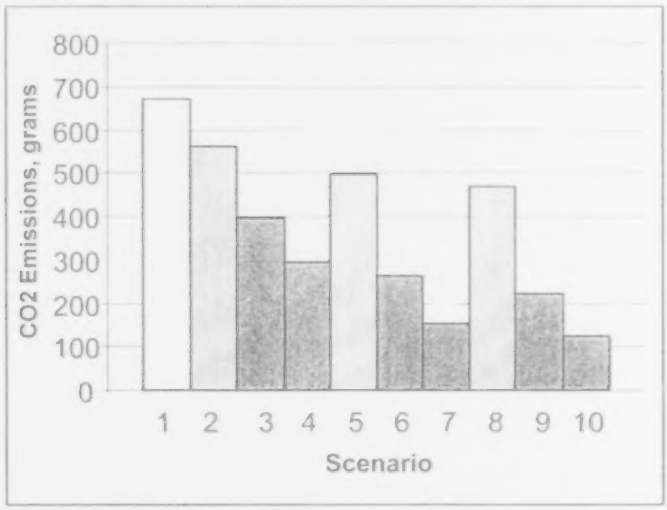

Figure 5-8 Average CO_2 Emissions Per Truck, Grams

For the purpose of estimating energy and environment benefits as a result of a DCBF implementation, two measures of effectiveness were used:

- Average fuel consumption per truck (millilitres), and
- Average CO_2 emission per truck (grams).

5.3.1 Fuel Consumption

Average fuel consumption due to delay is estimated to drop dramatically from the Base Scenario, in which an average of 253 mL of diesel fuel is used per truck to pass through the primary inspection service, to an average of 47 mL per truck when there is 100% industry participation and high agency participation in the DCBF initiative (Table 5-7).

Table 5-7 Average Diesel Fuel Consumption Per Truck, Millilitres

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		253			
	Low		Sc.2	Sc.3	Sc.4
			213	149	111
	Med		Sc.5	Sc.6	Sc.7
			187	99	58
	High		Sc.8	Sc.9	Sc.10
			177	83	47

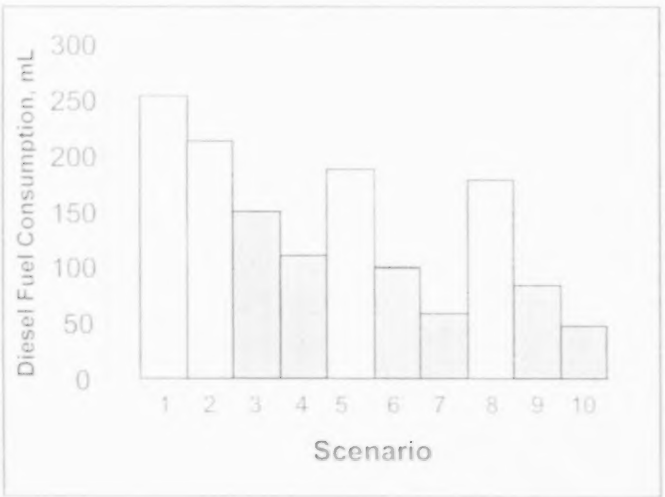

Figure 5-7 Average Diesel Fuel Consumption Per Truck, Millilitres

Figure 5-7 shows a similar pattern to the decreasing average fuel consumption with respect to increased agency and industry participation as with the other measures of effectiveness discussed previously. Again, the sensitivity towards industry participation (utilization of transponders) is greater than that of increased agency participation.

5.3.2 CO_2 Air Emissions

As CO_2 emissions rates of vehicles are proportional to the amount of fuel consumed, a similar pattern of decreasing CO_2 emissions is also estimated as agency and industry participation increases.

As shown in Table 5-8 and Figure 5-8, from a high of 669 grams of CO_2 emitted by the average commercial vehicle in the Base Scenario as a result of delay, the average CO_2 emissions drop down to a low of 126 grams per vehicle for Scenario 10.

Table 5-8 Average CO_2 Emissions Per Truck, Grams

		Industry Participation			
		Base	10%	50%	100%
Agency Participation	Base	Sc.1			
		669			
	Low		Sc.2	Sc.3	Sc.4
			564	396	293
	Med		Sc.5	Sc.6	Sc.7
			496	262	153
	High		Sc.8	Sc.9	Sc.10
			468	221	126

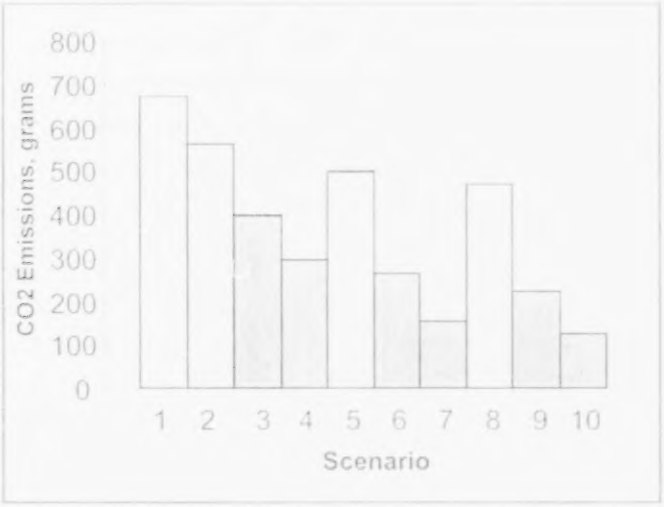

Figure 5-8 Average CO_2 Emissions Per Truck, Grams

To put the results of this measure into perspective, with approximately 400,000 trucks entering Canada from the Pacific Highway crossing, the annual total CO_2 produced due to border delay alone would be approximately 267 tonnes in the Base Scenario. At the other extreme case, with a full DCBF implementation (Scenario 10), the same 400,000 trucks would have produced 50 tonnes of CO_2, or 217 tonnes less than the Base Scenario.

5.4 Other Benefits

The benefits evaluated in sections 5.1 to 5.3 are by no means the complete list of possible benefits that a DCBF implementation could provide to border services agencies and their stakeholders and clients. The reduction of delay provides for a number of other savings that can be realized by various stakeholders. The availability of an automated and computerized pre-screening and rules-based DCBF system also provides for additional abilities that provide additional benefits. Although beyond the scope of this research, other benefits could include:

- Economic benefits from the spill-over effects of a more efficient and secure border
- Productivity benefits of border inspection services through reduced need for border staffing/resources, or alternatively, increased efficiency in the delivery of border services
- Effectiveness benefits by increasing the feasibility of just-in-time transport of highly time-sensitive cargo
- Safety benefits of knowing cargo contents and arrival times in advance to better prepare for sensitive or dangerous/hazardous cargo, as well as knowledge of the physical condition of trucks via on-board sensors in the future
- Positive multiplication effect of adapting technologies and standards that can benefit the commercial vehicle industry beyond the border (e.g., encouraging adoption and use of transponders can help in efficient weighing and safety inspections)
- Creating a long-term mechanism for agencies and industry to upgrade their legacy systems without requiring other stakeholders to upgrade their systems at the same time

6 IMPLEMENTATION CONCEPT

This section presents recommendations as to the next steps in the development and implementation of a DCBF. The recommendations are based on the results of the modelling and concept development of the DCBF, as well as the recommendations of two previous studies [2, 3]. These three studies have identified a number of desirable features for future CVO systems. Table 6-1 lists the desirable features and how they were addressed by each of the three studies. The DCBF concept allows for the implementation of the recommendations found in both of the other studies.

Table 6-1 Innovation Features with the Three Studies

Feature	DCBF R&D	Cost Benefit Study for ECRI [3]	CVO Network Study [2]
Flexible information exchange	XML information format, flexible, can be integrated into both the IRE and the CDE systems	Recommends flexible exchange format	Currently flat files are exchanged on IRE (Inter-provincial Record Exchange) system and the CDE (Carrier Data Exchange) system
Information standardization	DCBF would need to define an internal standard for all data types, but could support multiple standards	Recommends single standard at the national level, and recognizes the difficulty of dealing with multiple stakeholders	Recommends single standard at the national level, and recognizes the difficulty of dealing with multiple stakeholders
Stakeholder rules for releasing data	Allows entry of stakeholder rules dynamically	Defines the use of fixed rules and standards. In the cost benefit study, the example 4.1.3 and Figure 7-1 - Electronic Clearance Compliance Screen show rules in action	Not directly covered
Flexibility to create new data from existing information	Allows for authorization to create new data based on a set of information rules	Not directly covered. Recommended that the ability to download and query current trip information and alert data is a critical component for the screening process	Not directly covered

Feature	DCBF R&D	Cost Benefit Study for ECRI [3]	CVO Network Study [2]
Information management and long-term storage	Supports capability for creating information to generate new data	Identified as a need	A Canadian CVISN system is recommended
Dynamic query of database	XML message query rules allow for dynamic queries, including queries not previously defined	Covered under verification of load, route and permit information	Not directly covered
Internet	Allows North American access	Internet not covered. Recommended that the system support all North American carriers.	Allows for concept of other North American stakeholder access
Internet	Violations notification by e-mail to specific addresses or users according to stakeholder rules	Not covered. Study does identify that all North American users have access.	Mainly focuses on a single ITS CVO network and safety data exchange. Single carrier access, shippers, brokers, etc. was not addressed
Cost benefit implementing data exchange	Modelling shows that high participation by all groups results in high benefits	Modelling shows that high participation by all groups results in high benefits	Not directly covered
Supports major stakeholder groups Carriers, Shippers, provincial and territorial jurisdictions, U.S. jurisdictions, Transport Canada, CBSA, CBP	Solution supports all stakeholder groups	Solution supports all stakeholder groups	Solution supports all stakeholder groups

6.1 Prototype System

The next step in the development of a DCBF would be to create a prototype system. A prototype system would allow analysis of the DCBF and its functions against the current operating environment within a very physically confined area. The prototype would cover the CVO in the B.C. Lower Mainland. The initial prototype could then be expanded from the Lower Mainland to cover the remainder of the province, including the interfaces between the Yukon and Alberta systems, as well as the Alaska, Montana, Idaho, and Washington State systems. Once complete, the DCBF concept could be expanded from west to east in a linear process.

The DCBF R&D study recommends that the prototype be developed in the Lower Mainland, B.C. This area is a tightly defined transportation area, with physical borders of the ocean, mountains, and the U.S. border to confine the area required for the study. The Cost Benefit Study [3] includes the following recommendation: "Operationally it makes the most sense to complete implementation sequentially along the National Highway System so there is a coherent linear system of ECRI equipped stations". The Lower Mainland allows for the maximum evaluation to occur with the minimum amount of area to invest in.

6.1.1 Phase 1—B.C.-WSDOT Exchange of Information

The first phase of the prototype system would develop interfaces to the B.C. Solicitor General's offices and to the TCOS system being run by IMTC. Developing the brokerage rules for these two systems would allow for the discovery of integration issues in a very controlled environment. The CCMTA should manage the DCBF, as it could supply both an independent Inspection Verification and Validation (IVV) role as well as a venue for the carriers to perform analysis of the DCBF. The further extension of this activity would allow for the further development of the Pacific Trade Corridor.

6.1.2 Phase 2—Lower Mainland

The second phase of the prototype system would include all of the Lower Mainland, including the Fraser Valley and Whistler corridor. This would allow for the DCBF to address the number of issues with multiple users and jurisdictions.

6.1.3 Phase 3—B.C. Deployment

The final phase of the prototype would include the remainder of B.C., including interfaces to Yukon, Alberta, Montana, and Idaho systems. The operational development of a provincial DCBF would allow the national deployment to follow the lessons learned in the process. This deployment would allow the DCBF to satisfy a large percentage of the following initiatives in the B.C. Provincial Plan [4]:

a. Initiative No. 12 Safety & Legal Assurance Compliance Data Collection, Dissemination, & Sharing

b. Initiative No. 13 Roadside Electronic Screening

c. Initiative No. 14 Enhanced Border Clearance for Cargo & Vehicles

d. Initiative No. 15 Intermodal Freight Management

e. Initiative No. 17 Dangerous Goods Incident Response

f. Initiative No. 18 Information Warehousing

6.2 B.C. CVO Working Group

A technical working group needs to be created in B.C. to coordinate the technology exchange of CVO information. The largest obstacle for any CVO technical working group is the number of stakeholders involved. B.C. currently has an advantage over most jurisdictions, as there is a political mandate to amalgamate all police databases in the province, including all safety and security information. Although this working group

may be outside the realm of this political mandate, the safety of B.C. roads and driver information falls under the B.C. Solicitor General's office, along with the police security and safety issues.

6.3 DCBF Operational Funding

The development of a business model for the DCBF was outside the scope of this report. Since the DCBF concept supports both public and private groups of stakeholders, the funding of the implementation may be a good candidate for a private/public initiative. An appropriate feasibility and costing study is required to estimate usage level and to define the appropriate funding mechanisms to support the DCBF.

6.4 Special Event Security and Safety

Special Events (e.g., Olympics) require that CVO security and safety information be exchanged rapidly and be shared by a number of security agencies. Special Events require secure storage yards, monitored transportation corridors and secure event facilities. This could include a customs component. All vehicles and drivers entering the yards or facilities are verified. All traffic from the yards is tracked to site, along with identification of goods being carried. GIS, licence plate ID, biometrics, and smart card are all anticipated. Access to the yards is verified, along with access to specific venues. The plan is to know where everything is at all times: not only cargo, but transport personnel as well. All traffic is given a route to follow and a system monitors vehicle progress, with deviations (i.e., rules) resulting in alerts. The open architecture of the DCBF concept supports future integration with special event security solutions.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The U.S. and Canadian governments are becoming increasingly concerned about the level of security of freight and, in particular, container traffic.

The traditional approach of system design in the 20th century was to build with a single application in mind. However, this resulted in public and private industry obtaining multiple applications but paying for the same infrastructure multiple times. The DCBF project uses a 21st century design methodology to integrate multiple systems. This design methodology allows a cost-effective application of technology to support Canada's commercial vehicle operations.

The DCBF solution does not replace any existing system.

The DCBF is a data management facility that:

- Helps stakeholders to control the flow of information between their legacy systems and other stakeholders.
- Supports new levels of decision making and information security.
- Complements current legacy systems by supporting increased functionality.
- Supports long-term evolution of current operational systems into national and international operations.
- Creates a CVO environment to support national safety and security, travel safety, and emergency operations.
- Allows information exchange goals, set within the U.S./Canada Smart Border Action Plan for CVO, to be met.

The DCBF concept places emphasis on stakeholders who own their own data to control visibility and access to that data through submitted rules.

The DCBF management of CVO information, along with full participation of stakeholders, will create more efficient operations.

The University of British Columbia, through analysis of its modelling of the DCBF, verified that implementation of the DCBF would be beneficial in the areas of:

- environmental impact (i.e., CO_2 emissions)
- fuel
- time savings (trip duration, border crossing, etc.)

By selecting the Canadian and U.S. ITS architectures [6, 7] as a foundation for the design of the DCBF architecture, the development of the DCBF could be accomplished quickly and efficiently.

The DCBF project promotes a way forward for allowing cost-effective integration of technology and information management of Canada's CVO.

7.2 Recommendations

A four-phase approach to implementing the DCBF is recommended:

1. Creation of a prototype system connecting WSDOT TCOS with the BC-SG's CVO systems and allowing a number of stakeholders (including CBSA and CBP) access to brokered information.
2. Development and deployment of the system to support CVO in B.C.'s Lower Mainland.
3. Development and deployment of the system to support CVO in B.C. Upon completion of this phase, the system will also support multiple U.S. jurisdictions, a territory, and provincial interfaces.
4. Development and deployment of the system nationally.

The recommended next step is to perform a cost-benefit analysis of implementing the DCBF prototype (i.e., Phase 1). This prototype system would develop interfaces to the BC-SG's CVO systems and the TCOS system being run by WSDOT. Developing the brokerage rules for these two systems will uncover any integration issue in a very controlled environment.

It is recommended that, for the longer-term execution of a Canada-wide DCBF implementation, a national champion be identified to support the capture of operating requirements for all the stakeholders.

REFERENCES

As part of the study, a large review of literature was undertaken to acquire references to similar DCBF concepts and requirements. The documents reviewed during the literature review are listed in Appendix A.

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APPENDIX A LITERATURE REVIEW REFERENCES

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APPENDIX B ITS CVO IN B.C.

This appendix provides additional information about the regional B.C. stakeholders.

Stakeholders

The following list represents some of the potential users of the DCBF for exchanging data with a B.C. DCBF.

- Public Works and Government Services Canada
- B.C. Ministry of Transportation
- British Columbia Solicitor General
- U.S. Customs and Border Protection
- Insurance Corporation of British Columbia (ICBC)
- TransLink (Greater Vancouver Transportation Authority)
- Environment Canada
- Commercial fleet operators
- Canada Border Services Agency (CBSA)
- Vancouver Port Authority
- Washington State Department of Transportation

APPENDIX C TCOS AND XML

This appendix was added to give some insight into TCOS and XML and how TCOS uses XML in its distribution of information.

C1 XML

XML was developed by a world-wide working group and is described as " Extensible Markup Language (XML) is a simple, very flexible text format derived from Standard Generalized Markup Language (SGML) (ISO 8879). Originally designed to meet the challenges of large-scale electronic publishing, XML is also playing an increasingly important role in the exchange of a wide variety of data on the Web and elsewhere." The current recommended version of the documentation can be found on the web and is titled "*Extensible Markup Language (XML) 1.0 (Third Edition)* **W3C Recommendation** 4th February 2004, François Yergeau, Tim Bray, Jean Paoli, C. M. Sperberg-McQueen, Eve Maler".

XML is a method of describing a documentation format. Each exchange of information is in a logical form in an electronic document between two systems. XML provides a method for defining these documents and the method in which they are exchanged. There are two major components of XML that are of interest to the DCBF: the XML Query Language and the XML Schema. XML Query Language provides flexible query facilities to extract data from real and virtual XML documents on the Web. XML Schemas provide mechanisms to define and describe the structure, content, and to some extent semantics of XML documents.

C2 TCOS

Trade Corridor Operation System (TCOS) was developed by the Washington State Department of Transportation (WSDOT) as a U.S. Federal Highway Administration funded project to apply ITS technologies to border operations at the Washington/British

Columbia border. The system integration firm TransCore was hired to assist in the technical aspects of the project and started by developing a technical committee that included staff from the ports of Seattle and Tacoma, U.S. Customs, several maritime shipping lines, and British Columbia's Ministry of Transportation (BCMOT).

This in-bond system is designed to monitor and facilitate the movement of northbound trucks carrying containerized, in-bond freight through the Blaine/Douglas commercial port of entry.

Phase 1 of the ITS project employs a Federal Highways Administration (FHWA) standard time division multiple access dedicated short-range communication transponder tag to track in-bond containers trucked from the ports of Seattle or Tacoma into Canada. The tags, which are the same tags used for Washington's popular freeway speed weigh-in-motion system, are installed in the cab of safe, legal, and registered trucks. The system utilizes the unique tag serial number to reference carrier and vehicle credentials, as well as cargo invoice information and manifest data.

Automatic vehicle identification (AVI) readers are installed at the exit gates of the American President Lines terminal at the Port of Seattle and at the Maersk Sealand terminal at the Port of Tacoma. As the commercial vehicle exits, these gate systems detect the tag, and software references the container and in-bond information and posts it on the project's web site. The system also alerts U.S. Customs and other users that a container has left the marine terminal and is heading north. Additional AVI readers installed at two weigh stations along I-5 provide additional en route information. An advanced AVI reader installed a quarter of a mile south of the border gives U.S. Customs Inspectors at the Blaine commercial crossing sufficient time to preview the in-bond transaction status before the truck arrives. The Inspectors may then allow the container and truck to pass through the border with little or no delay. A final reader at the border automatically clears out the bond on the shipment and marks the cargo as exported. The responsible carrier is simultaneously notified of the decrementation. This automatic decrementation helps to eliminate ongoing problems associated with "lost" in-bond shipments and paperwork errors.

In addition to the hardware, the ITS uses the TCOS information management system (found at www.transcorridor.com). This Internet-based system links the AVI readers, the shipping line's information system, and U.S. Customs' Automated Manifest System (AMS). Currently, the system is being operated in a service centre in San Diego by WSDOT's system integrator (TransCore). For security and privacy protection, information from the TCOS is available only to authorized, registered users. The information on the TCOS web site includes the read location, date/time, in-bond number, the container number, the bill of lading number, and commercial vehicle number associated with this transaction along with the transponder serial number that can be used to identify the vehicle and shipping agent. Advance, pre-processing, and targeting information is available to authorized users by accessing the project's TCOS web site. In addition, Customs and other enforcement agencies can customize the screen to include cautionary, security, and targeting information.

C3 TCOS XML Interface

The following documents define the XML version of the TCOS Event Report. TCOS XML documents have file names in the form:

TCOS_EVENTREPORT_YYYYMMDD_HHMMSS_FFF.txt

C3.1 XML Specification Document

The following is a sample of the TCOS event reporting in XML format following the XML world standards set out by WWW.W3.org. This format allows for any group of parties to create an interface to this message following the attached specification. By extracting the following and placing into a web page, the XML Schema for this message will be displaced and validated according to the world standards.

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema"
elementFormDefault="qualified" attributeFormDefault="unqualified">
      <xsd:element name="Envelope">
            <xsd:annotation>
                  <xsd:documentation>Transmission of an
Event</xsd:documentation>
            </xsd:annotation>
            <xsd:complexType>
                  <xsd:all>
                        <xsd:element name="Header"
type="TransmissionHeader"/>
                        <xsd:element ref="Body"/>
                  </xsd:all>
            </xsd:complexType>
      </xsd:element>
      <xsd:complexType name="TransmissionHeader">
            <xsd:all>
                  <xsd:element name="MessageType" type="xsd:string"
minOccurs="0" maxOccurs="1"/>
                  <xsd:element name="SenderReferenceIdentifier"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                  <xsd:element name="SenderReferenceQualifier"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                  <xsd:element name="UserName" type="xsd:string"
minOccurs="0" maxOccurs="1"/>
                  <xsd:element name="Password" type="xsd:string"
minOccurs="0" maxOccurs="1"/>
                  <xsd:element name="AcknowledgementMethod"
minOccurs="0" maxOccurs="1">
                        <xsd:complexType>
                              <xsd:choice>
                                    <xsd:element name="Email"
type="xsd:string"/>
                                    <xsd:element name="URL"
type="xsd:string"/>
```

```
                                    <xsd:element name="PhoneNumber"
type="xsd:string"/>
                                    <xsd:element name="FaxNumber"
type="xsd:string"/>
                              </xsd:choice>
                        </xsd:complexType>
                  </xsd:element>
            </xsd:all>
      </xsd:complexType>
      <xsd:element name="Body">
            <xsd:complexType>
                  <xsd:sequence minOccurs="0" maxOccurs="unbounded">
                        <xsd:element name="TCOS_EVENTREPORT">
                              <xsd:complexType>
                                    <xsd:sequence>
                                          <xsd:element name="LOC"
type="xsd:string" minOccurs="1" maxOccurs="1"/>
                                          <xsd:element name="DIR"
type="xsd:string" minOccurs="1" maxOccurs="1"/>
                                          <xsd:element name="START"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="DEST"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="LANE"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="TIME"
type="xsd:string" minOccurs="1" maxOccurs="1"/>
                                          <xsd:element name="UPDATE"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="LATITUDE"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="LONGITUDE"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="VEHTYPE"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="SHIP"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="TRAIN"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="RAILCAR"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="TRUCK"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="TAG"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="STICKER"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="DRIVERLIC"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="DRIVER"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="CREW"
type="xsd:string" minOccurs="0" maxOccurs="4"/>
                                          <xsd:element name="CONT"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="CONTCHK"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                          <xsd:element name="CONTTAG"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
```

```
                                        <xsd:element name="AGENT"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                        <xsd:element name="INBOND"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                        <xsd:element name="SEALS"
type="xsd:string" minOccurs="0" maxOccurs="4"/>
                                        <xsd:element name="ESEAL"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                        <xsd:element name="TAMPER"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                        <xsd:element name="INSPECTOR"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                        <xsd:element name="HAZMAT"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                        <xsd:element name="OFFROUTE"
type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                        <xsd:element
name="TRAVELSTAT" type="xsd:string" minOccurs="0" maxOccurs="1"/>
                                    </xsd:sequence>
                                </xsd:complexType>
                            </xsd:element>
                        </xsd:sequence>
                    </xsd:complexType>
            </xsd:element>
</xsd:schema>
```

C3.2 TCOS XML Sample Data Document

The following is sample data for the previously defined TCOS XML Schema. By following the standards for XML this data can be validated against the schema defined for this message. XML only allows valid data to be excepted through the schema used.

```
<?xml version="1.0" encoding="UTF-8"?>

<Envelope xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:noNamespaceSchemaLocation="file:TCOS_EVENTREPORT.xsd" >

<Header>
<MessageType>TCOS Event Report</MessageType>
<SenderReferenceIdentifier>TransCore TCOS</SenderReferenceIdentifier>
<SenderReferenceQualifier>TCOS</SenderReferenceQualifier>
<UserName>tcos</UserName>
<Password>pw</Password>
<AcknowledgementMethod>
<Email>tcosmail@cts.com</Email>
</AcknowledgementMethod>
</Header>

<Body>

<TCOS_EVENTREPORT>
<LOC>CerestarBarby.SDock</LOC>
<DIR>Out</DIR>
```

```
<START>CerestarBarby.SDock</START>
<DEST>HolmanDistKent.EntryGate</DEST>
<LANE>1</LANE>
<TIME>2004-03-02T06:05:13.971</TIME>
<UPDATE>N</UPDATE>
<LATITUDE>45.000000</LATITUDE>
<LONGITUDE>110.000000</LONGITUDE>
<VEHTYPE>Truck</VEHTYPE>
<SHIP>WESTWOOD COLUMBIA</SHIP>
<TRAIN>UPRR2379</TRAIN>
<RAILCAR>UPRR123456789O123456</RAILCAR>
<TRUCK>EDGMON, 12345</TRUCK>
<TAG>2080A7B3</TAG>
<STICKER>123456789ABCDEFG</STICKER>
<DRIVERLIC>N1234567</DRIVERLIC>
<DRIVER>123456789ABCDEFG</DRIVER>
<CREW>123456789ABCDEFH</CREW>
<CREW>123456789ABCDEFI</CREW>
<CREW>123456789ABCDEFJ</CREW>
<CREW>123456789ABCDEFK</CREW>
<CONT>ABCD123456</CONT>
<CONTCHK>7</CONTCHK>
<CONTTAG>OSC001</CONTTAG>
<AGENT>WSL</AGENT>
<INBOND>PT123456789</INBOND>
<SEALS>123456789ABCDEFG</SEALS>
<SEALS>123456789ABCDEFH</SEALS>
<SEALS>123456789ABCDEFI</SEALS>
<SEALS>123456789ABCDEFJ</SEALS>
<ESEAL>HEHA01052675</ESEAL>
<TAMPER>N</TAMPER>
<INSPECTOR>COTECNA12345678</INSPECTOR>
<HAZMAT>N</HAZMAT>
<OFFROUTE>N</OFFROUTE>
<TRAVELSTAT>N</TRAVELSTAT>
</TCOS_EVENTREPORT>

</Body>

</Envelope>
```

APPENDIX D SIMULATION MODEL EXPERIMENTAL DESIGN

This appendix contains modelling information used to support the benefits outlined in Section 5 of the main report.

D1 Inputs and Assumptions

D1.1 Truck Arrival Rates

Hourly border truck traffic arrival data for a 24-hour period to the Pacific Highway crossing was provided by CBSA[1] and the profile is shown in Figure D-1. This data was from the site model simulation done in 2002 and was sufficient as input to the generation of arrival rates for trucks in the simulation model.

[1] Provided by Ms. Janice Baird, Senior Project Advisor, Strategy and Co-ordination Branch, CBSA. Nov. 15, 2004.

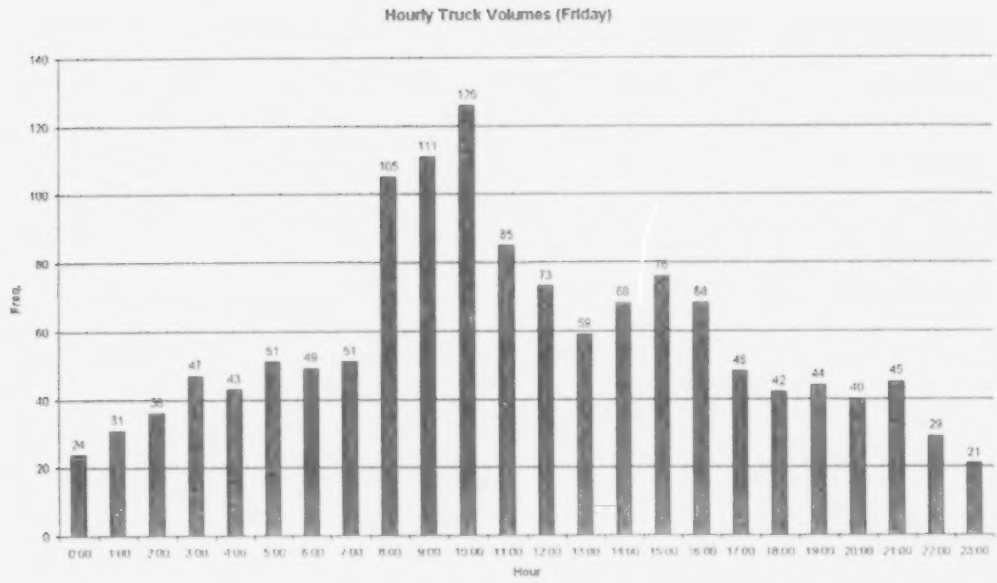

Figure D-1 Truck Hourly Arrival Rates, 24 hr Period

D1.2 Assignment of Truck Attributes

For every truck transaction generated, attributes were assigned that were used during the simulation modelling process. Table D-1 shows the following attributes that were assigned to each transaction and a description of their use and possible values:

Table D-1 Truck Hourly Arrival Rates, 24 hr Period

Attribute	Description	Possible Value (in brackets) and Probability Distribution (in %)
Truck Type	Average primary inspection times were a function of truck type (information provided by CBSA)	Driver completes own documentation - avg. (72.5 sec); 7.0% Empty - avg. (48.2 sec); 46.0% Cargo—referred for inspection or documentation - avg. (77.4 sec); 17.1% Cargo—released - avg.(80.9 sec); 24.2% Cargo—in-transit - avg. (69.8 sec); 1.2% Cargo—in bond - avg. (57.4 sec); 4.5%
Transponder Utilization	A scenario control parameter that determines the probability of trucks utilizing transponders (industry participation rate)	Value: (1) if true; (0) if false 0%, 10%; 50%; or 100%, depending on Scenario
*Driver	DCBF rule variable describing driver history	OK (5): 60% Questionable (4): 25% 1 Violation Record (3): 8% Multiple Records (2): 5% Different Driver (1): 2%
*Cargo	DCBF rule variable describing cargo status	Correct Cargo (2): 95% Wrong Cargo (1): 5%
*Schedule Adherence	DCBF rule variable describing truck adherence to schedule status	On Time (3): 85% Small differential (2): 10% Large differential (1): 5%
*E-Seal Utilization	DCBF rule variable describing E-Seal utilization	No E-Seal (0): 90% Have E-Seal: (1) 10%
*E-Seal Status	DCBF rule variable describing E-Seal status	OK (2): 95% Broken (1): 5%

* The values and probability distributions for these attributes were not provided and therefore assumed. These attributes influence the primary inspection process for a given truck only when a transponder is available.

Other than the Transponder Utilization attribute, all of the attributes were subject to the same probability distribution for each of the 10 scenarios. This allowed a controlled environment to test only the changes in each of the simulation scenarios, which were changes to the combination of agency participation rate (a function of information or attributes available to the DCBF for rules checking) and industry participation rate (a function of the utilization of transponders by commercial vehicles). In this regard, the issue of the accuracy of the hypothetical attribute values and corresponding distributions is not as significant. Given also the fact that such information was either unobtainable (highly classified information) or unavailable, assumptions as to the values and distributions for the attributes were required and the output of the simulation model runs should be interpreted in light of these assumptions.

D1.3 Estimation of Primary Inspection Delays

Delays experienced by each truck transaction at the primary inspection booth were a function of not only the attributes as described in the previous section, but also a function of agency participation rates. The model considered the influence of agency participation rates to the delay by utilizing separate delay equations for each of following the agency participation rates:

No Agency Participation (Base Scenario 1)

$$Delay_{Base} = 17 + 20 + tria(Avg\ Pr imaryServiceTime) \quad (1)$$

Low Agency Participation (Scenarios 2, 3 and 4)

$$Delay_{Base} = (17 + 20 + tria(Avg\ Pr imaryServiceTime)) - Transponder * (Driver * 2) \quad (2)$$

Medium Agency Participation (Scenarios 5, 6, and 7)

$$Delay_{Base} = (17 + 20 + tria(Avg\ Pr imaryServiceTime)) - Transponder * ((Driver * 2) + (C\arg o * 3) + (HaveESeal * ESeal * 3)) \quad (3)$$

High Agency Participation (Scenarios 8, 9, and 10)

$$Delay_{Base} = (17 + 20 + tria(Avg\ Pr imaryServiceTime)) - Transponder * ((Driver * 2) + (C\arg o * 3) + (HaveESeal * ESeal * 3) + (Schedule * 2)) \quad (4)$$

where:

tria(AvgPrimaryServiceTime) represents a triangular distribution of additive primary inspection service times with an average time determined

by the truck type, and min. and max. times defined by factors of 0.7 and 2.0 of this average time, respectively.

The constant term of 20 seconds represents a minimum primary inspection service time for all transactions, regardless of type. The constant term of 17 seconds represents the time for commercial vehicles to pull up from first-in-queue to a complete stop at a primary inspection booth.[2] The total primary inspection service time is therefore the sum of the pull-up time (i.e., 17 seconds), minimum inspection service time (i.e., 20 seconds), and the additive triangular distribution of average primary inspection times as previously described.

The influence of transponder utilization is a reduction in service times due to the benefit of providing information in advance of primary inspection, allowing the DCBF system to assist in the assessment of transponder-equipped trucks. Generally, the higher the agency participation, the more information is provided to the DCBF system, resulting in a greater reduction in time required for primary inspection.

[2] Nozick, Linda K., M. A. Turnquist, F. J. Wayno, G. F. List, T. L. Wu and B. Menyuk. 1999. *Evaluation of advanced information technology at the Peace Bridge*. Prepared for the Buffalo and Fort Erie Public Bridge Authority, Buffalo, NY, and Fort Erie, ON.

D2 Modelling Flowcharts and Coding

D2.1 General Modelling Process

With the simulation model inputs and assumptions as described in Section D1, the general modelling process is illustrated in Figure D-2.

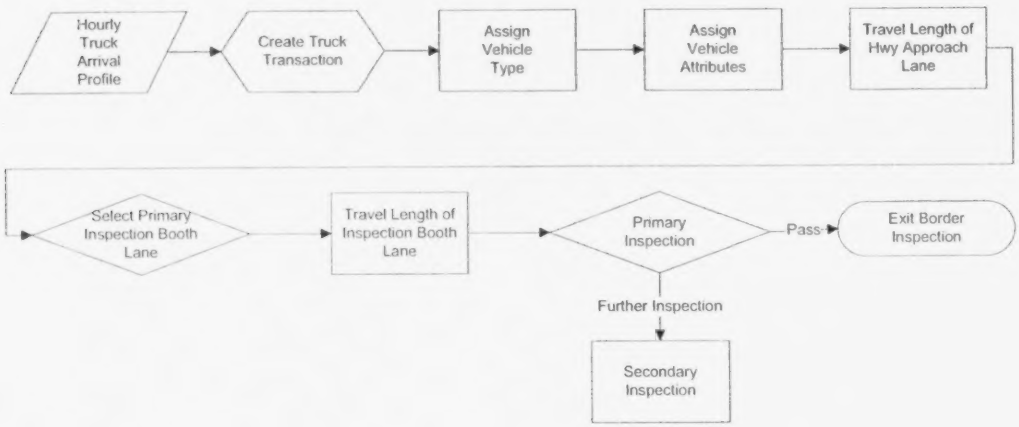

Figure D-2 General Simulation Modelling Process

D2.2 Detailed Simulation Model Flowchart

The simulation model was developed and run in Arena, a discrete-even simulation software package developed by Rockwell Software Inc. The following Figures D-3 to D-5 illustrate the simulation model flowchart developed to perform the 200 simulation runs in the evaluation of the 10 DCBF implementation scenarios.

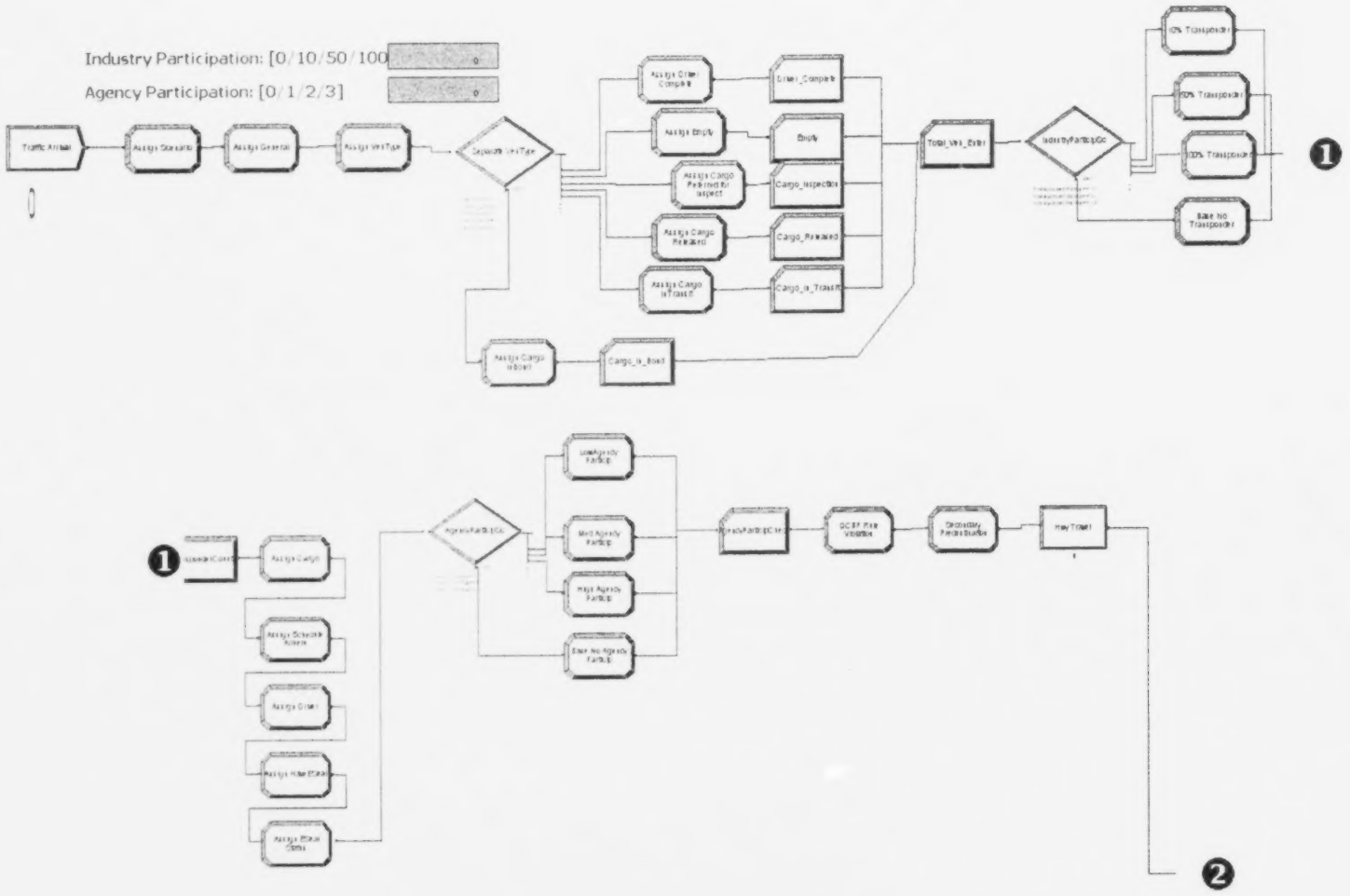

Figure D-3 Creation of Transactions and Assignment of Attributes

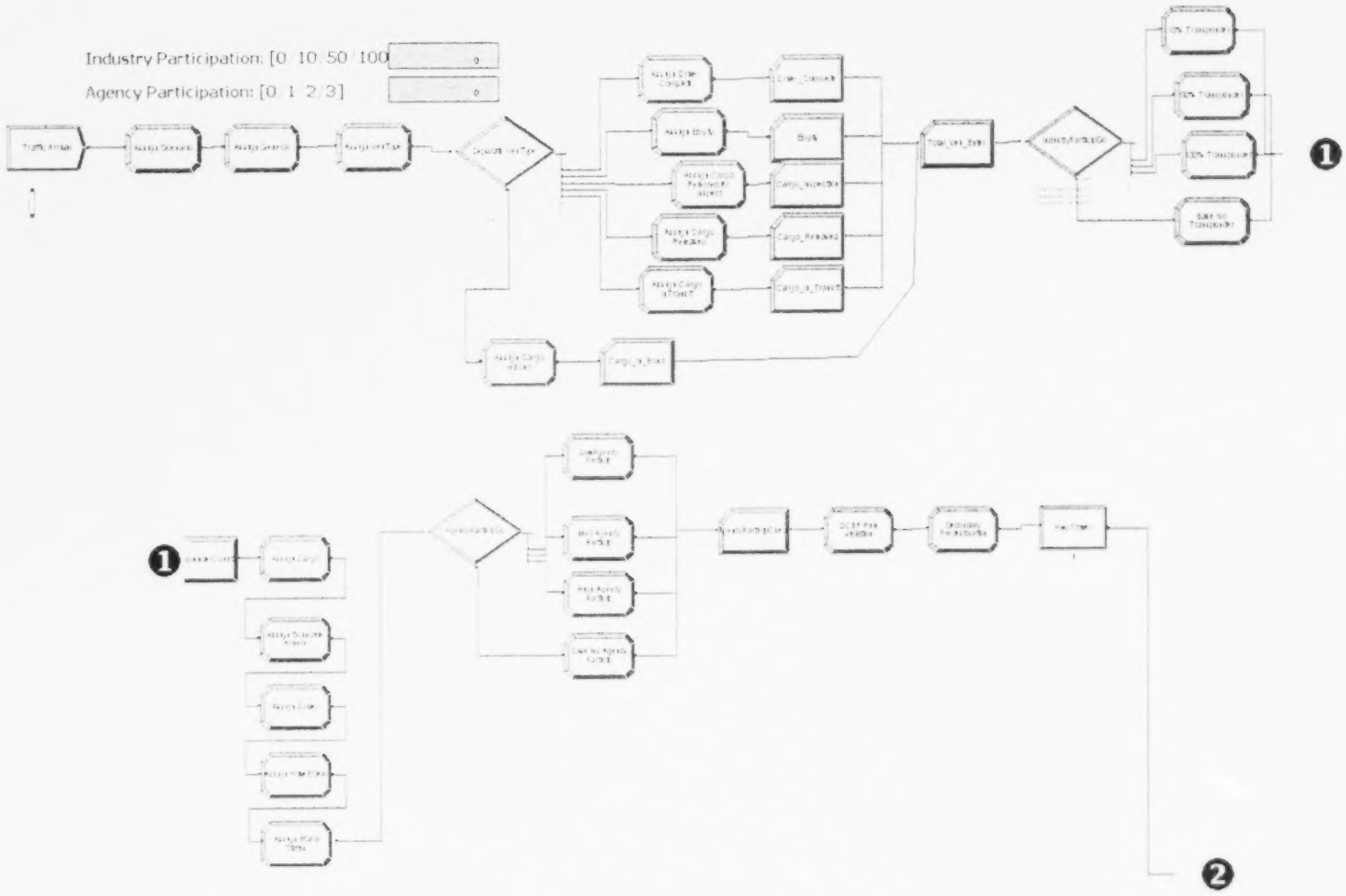

Figure D-3 Creation of Transactions and Assignment of Attributes

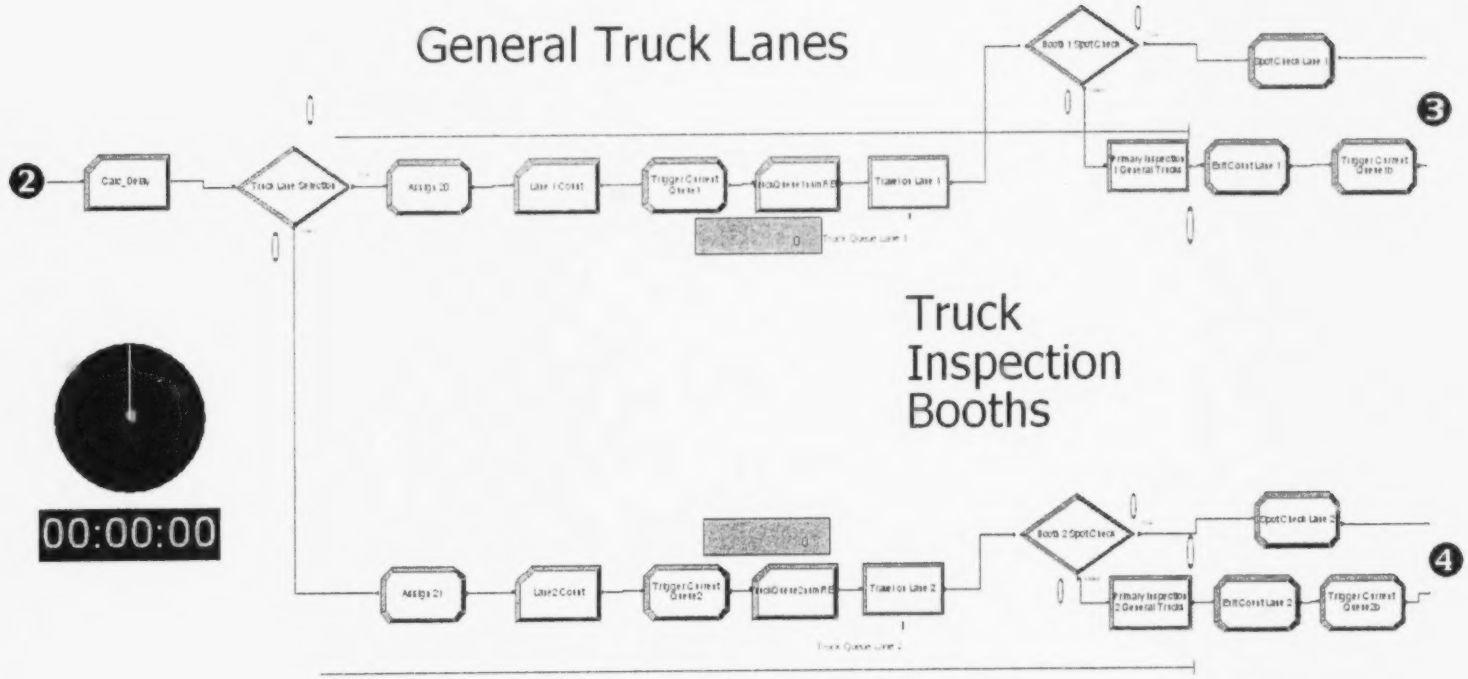

Figure D-4 Primary Inspection Booth Lane Selection and Inspection Logic (1)

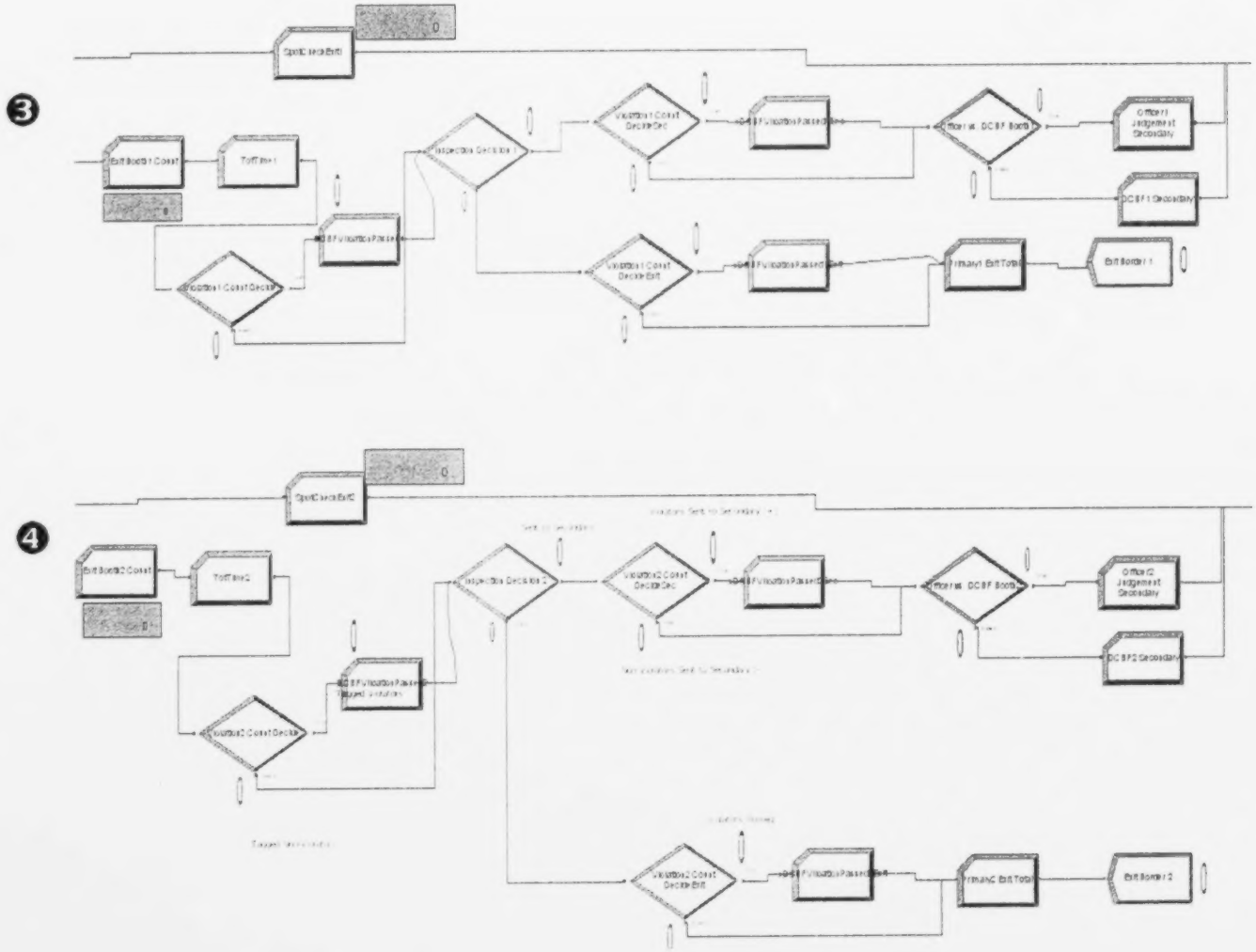

Figure D-5 Primary Inspection Process Logic (2)

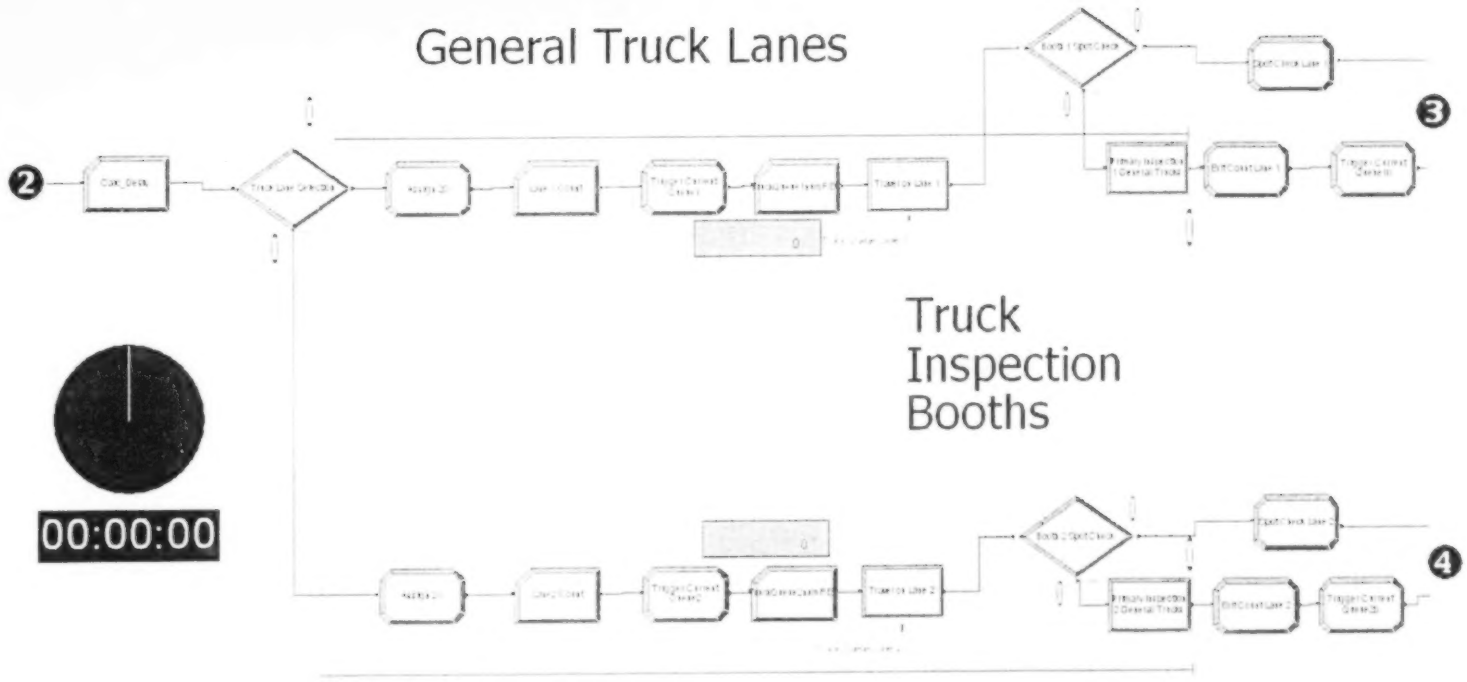

Figure D-4 Primary Inspection Booth Lane Selection and Inspection Logic (1)

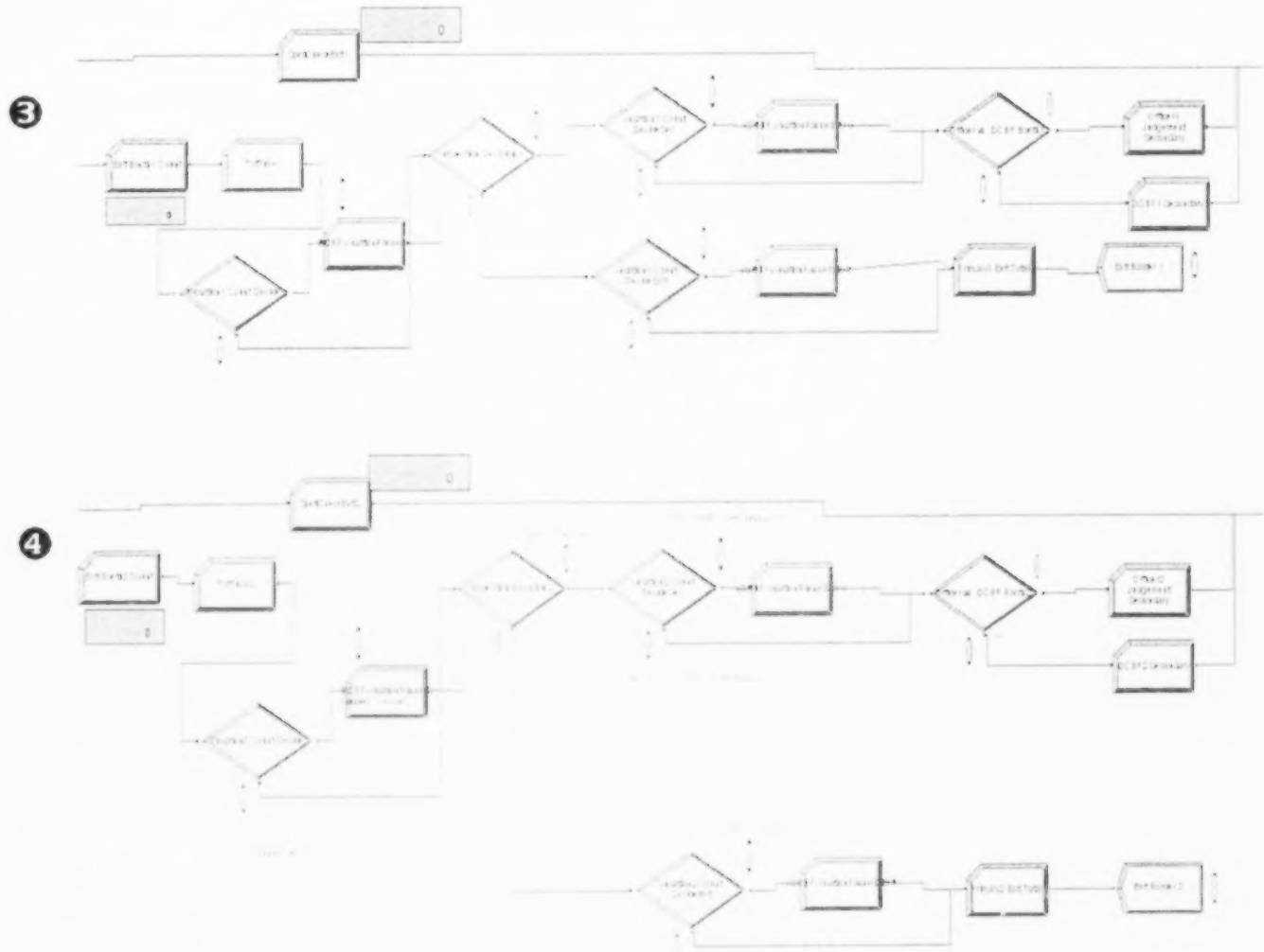

Figure D-5 Primary Inspection Process Logic (2)

APPENDIX E WSDOT SAFER XML DOCUMENT FORMAT

As part of the DCBF concept to support U.S. safety information, in this case the WSDOT Safety and Fitness Electronic Records system (SAFER) data, the demonstration software included the reception of the Carrier Snapshot. The snapshot was not processed any further than the XML message parsing, and notification that the message was received. Section E1.1 contains the message that was processed by the Demo DCBF.

The following is a summary of the WSDOT XML approach.

WSDOT developed a XML approach to handling SAFER information using XML standards. This appendix contains the XML schema for this approach. The text has been modified from the original WSDOT Safer text to reflect a DCBF interface. The maximum allowed transactions per package are specified for each snapshot or view.

The frequency that the DCBF will upload data from and to SAFER will greatly depend on the data process cycle timing of the associated legacy systems within a jurisdiction and the information authorized to be exchanged with the SAFER system.

The frequency that a jurisdiction will download data from SAFER is expected to be no more often than every 5 minutes for vehicle data and no more often than hourly for carrier data. SAFER will batch snapshot transactions at this frequency.

XML Notes

The Document Type Definitions (DTDs) in this section indicate which data elements are mandatory and which are optional. That information is also documented in the *SAFER Option Working Group Jurisdiction - SAFER Proposed Flat File and XML Interfaces Data Dictionary*. In the DTD, the optional character following an element governs whether the element may occur one or more (+), zero or more (*), or zero or one times (?). The absence of such an operator means that the element must appear exactly once.

For example, in the element type declaration:

<!ELEMENT NAMES (NAME_TYPE, BUSINESS_OR_LAST_NAME, FIRST_NAME?, MIDDLE_NAME?, SALUTATION?, TITLE?, SUB_TITLE?, ADDRESSES+)>

The child elements NAME_TYPE and BUSINESS_OR_LAST_NAME must appear exactly once. The child elements FIRST_NAME, MIDDLE_NAME, SALUTATION, TITLE and SUB_TITLE may appear zero or one time, and the child element ADDRESSES may occur once or more.

In XML, an element with no content is said to be empty. The representation of an empty element is either a start-tag immediately followed by an end-tag, or an empty-element tag. However, since the DTD specifies certain elements as optional, those elements are not required to be sent in the document as empty elements. For example, any of the following three representations depicted in Figures E-1 to E-3 would be equivalent and valid according to the DTDs in this section:

```
<ADDRESSES>
        <ADDRESS_TYPE>2</ADDRESS_TYPE>
        <ADDR_LINE_1>11100 Johns Hopkins Road</ADDR_LINE_1>
        <CITY>Laurel</CITY>
        <STATE>MD</STATE>
        <ZIP_CODE>207236009</ZIP_CODE>
        <COUNTY>Howard</COUNTY>
        <COUNTRY>US</COUNTRY>
</ADDRESSES>
```

Figure E-1 "Addresses" With No Empty Elements

```
<ADDRESSES>
        <ADDRESS_TYPE>2</ADDRESS_TYPE>
        <ADDR_LINE_1>11100 Johns Hopkins Road</ADDR_LINE_1>
        <ADDR_LINE_2></ADDR_LINE_2>
        <PO_BOX></PO_BOX>
        <CITY>Laurel</CITY>
        <STATE>MD</STATE>
        <ZIP_CODE>207236009</ZIP_CODE>
        <COUNTY>Howard</COUNTY>
        <COLONIA></COLONIA>
        <COUNTRY>US</COUNTRY>
</ADDRESSES>
```

Figure E-2 "Addresses" With Empty Elements

```
<ADDRESSES>
        <ADDRESS_TYPE>2</ADDRESS_TYPE>
        <ADDR_LINE_1>11100 Johns Hopkins Road</ADDR_LINE_1>
        <ADDR_LINE_2/>
        <PO_BOX/>
        <CITY>Laurel</CITY>
        <STATE>MD</STATE>
        <ZIP_CODE>207236009</ZIP_CODE>
        <COUNTY>Howard</COUNTY>
        <COLONIA/>
        <COUNTRY>US</COUNTRY>
</ADDRESSES>
```

Figure E-3 "Addresses" With Empty Elements, Using Empty-Element Tag

---

For XML data exchanges between SAFER and a jurisdiction's CVIEW and/or legacy systems, it is not required that optional elements with null values be sent in the XML document as empty elements. When data is uploaded to SAFER as an XML document and optional data elements do not appear in a transaction and they exist in the SAFER database, the existing data will be deleted or set to null. When data is downloaded from SAFER to a state system as an XML document, it is assumed that optional fields with null values will not appear in the document and that the corresponding data in the jurisdiction system will be deleted or set to null.

A transaction completely replaces its associated data in SAFER. In other words, all data that is desired in SAFER for a snapshot view must be uploaded each time a transaction is uploaded for the snapshot view.

E1.1 XML DTD for Full Carrier Snapshot

Each package can contain a maximum of 5000 transactions (i.e., <SAFER_UPDATE_PACKAGE_TRANSACTION> structures).

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- created 8-17-2001 -->
<!-- full carrier_V05_dtd.dtd -->
<!ELEMENT ACTIVITY_CODE (#PCDATA)>
<!ELEMENT ADDRESSES (ADDRESS_TYPE, ADDR_LINE_1, ADDR_LINE_2?, PO_BOX?, CITY, STATE,
ZIP_CODE, COUNTY, COLONIA?, COUNTRY)>
<!ELEMENT ADDRESS_TYPE (#PCDATA)>
<!ELEMENT ADDR_LINE_1 (#PCDATA)>
<!ELEMENT ADDR_LINE_2 (#PCDATA)>
<!ELEMENT BOND_TRUST_FUND_REQD (#PCDATA)>
<!ELEMENT BOND_TRUST_FUND_STATUS (#PCDATA)>
<!ELEMENT BOND_TRUST_FUND_SUMMARY (#PCDATA)>
<!ELEMENT BROKER_AUTHORITY_STATUS (#PCDATA)>
<!ELEMENT BULK_NONBULK (#PCDATA)>
<!ELEMENT BUS (#PCDATA)>
<!ELEMENT BUSINESS_OR_LAST_NAME (#PCDATA)>
<!ELEMENT CANCELLATION_EFFECTIVE_DATE (#PCDATA)>
<!ELEMENT CARGO_CODE (#PCDATA)>
<!ELEMENT CARGO_INSURANCE_REQD (#PCDATA)>
<!ELEMENT CARGO_INSURANCE_STATUS (#PCDATA)>
<!ELEMENT CARGO_INSURANCE_SUMMARY (#PCDATA)>
<!ELEMENT CARGO_OTHER_DESC (#PCDATA)>
<!ELEMENT CARRIER (CARRIER_ID_NUMBER, ISSUING_AUTHORITY?, TERMINAL_ID?, ICC_NUMBER_1,
ICC_NUMBER_2?, ICC_NUMBER_3?, STATE_CARRIER_ID?, TAX_ID_TYPE, TAX_ID_NUMBER,
CARRIER_NAME, DBA_NAME?, OIC_NUMBER?, REGION_CODE?, TERRITORY_CODE?, STREET?, COLONIA?,
CITY?, STATE?, ZIP_CODE?, COUNTY_CODE?, COUNTRY?, TELEPHONE_AREA_CODE?,
TELEPHONE_NUMBER?, FAX_NUMBER?, EMAIL_ADDRESS?, MAIL_STREET?, MAIL_COLONIA?, MAIL_CITY?,
MAIL_STATE?, MAIL_ZIP_CODE?, MAIL_COUNTY_CODE?, BUS?, QUANTITY_POWER_UNITS?,
QUANTITY_MOTOR_COACHES?, QUANTITY_HAZMAT_TANK_TRAILERS?, QUANTITY_HAZMAT_TANK_TRUCKS?,
QUANTITY_LIMOS?, QUANTITY_SCHOOL_BUSES?, QUANTITY_TRAILERS?, QUANTITY_TRUCK_TRACTORS?,
QUANTITY_TRUCKS?, QUANTITY_VANS?, QUANTITY_CARS?, QUANTITY_DRIVERS?,
QUANTITY_DRIVERS_CDL?, QUANTITY_DRIVERS_INTERSTATE?, QUANTITY_DRIVERS_INTRASTATE?,
MCMIS_STATUS?, MCMIS_REASON_INACTIVATED?, MCMIS_TRANSACTION_DATE?, MCMIS_STATUS_DATE?,
FILE_CREATE_DATE?, DATE_ADDED?, LAST_UPDATE_DATE?, LAST_UPDATE_USERID?,
CARRIER_HAZMAT_PLACARDED?, CARRIER_RATEABLE?, ENTITY_TYPE?, CARRIER_INTERSTATE?,
CARRIER_INTERSTATE_HM?, CARRIER_INTERSTATE_NHM?, CARRIER_INTRASTATE_NHM?,
CARRIER_INTRASTATE_HM?, SHIPPER_INTERSTATE?, SHIPPER_INTERSTATE_HM?,
SHIPPER_INTRASTATE_HM?, HAZMAT_STATUS?, PRIOR_DATE?, QUANTITY_INSPECTIONS_LAST24?,
QUANTITY_HAZMAT_PRESENT_LAST24?, VEHICLE_INSPECTIONS_LAST24?, DRIVER_INSPECTIONS_LAST24?,
OOS_ALL_TYPES_LAST24?, OOS_VEHICLE_INSPECTIONS_LAST24?, OOS_DRIVER_INSPECTIONS_LAST24?,
OOS_HAZMAT_INSPECTIONS_LAST24?, QUANTITY_INSPECTIONS_LAST30?,
QUANTITY_HAZMAT_PRESENT_LAST30?, VEHICLE_INSPECTIONS_LAST30?, DRIVER_INSPECTIONS_LAST30?,
OOS_ALL_TYPES_LAST30?, OOS_VEHICLE_INSPECTIONS_LAST30?, OOS_DRIVER_INSPECTIONS_LAST30?,
OOS_HAZMAT_INSPECTIONS_LAST30?, QUANTITY_INSPECTIONS_LAST15?,
QUANTITY_HAZMAT_PRESENT_LAST15?, VEHICLE_INSPECTIONS_LAST15?, DRIVER_INSPECTIONS_LAST15?,
OOS_ALL_TYPES_LAST15?, OOS_VEHICLE_INSPECTIONS_LAST15?, OOS_DRIVER_INSPECTIONS_LAST15?,
OOS_HAZMAT_INSPECTIONS_LAST15?, VIOLATION_BRAKES?, VIOLATION_LIGHTS?, VIOLATION_WHEELS?,
VIOLATION_STEERING?, VIOLATION_MEDICAL_CERTIFICATE?, VIOLATION_LOGS?, VIOLATION_HOURS?,
VIOLATION_LICENSE?, VIOLATION_DRUGS?, VIOLATION_TRAFFIC?, VIOLATION_PAPERS?,
VIOLATION_PLACARDS?, VIOLATION_OP_EMER_RESP?, VIOLATION_TANK?, VIOLATION_OTHER?,
SAFETY_RATING?, RATING_DATE?, REVIEW_INVESTIGATOR_CODE?, REVIEW_TYPE?, REVIEW_DATE?,
RECORDABLE_CRASHES?, PREVENTABLE_CRASHES?, MILEAGE?, REVIEW_MEDICAL_CERTIFICATE?,
REVIEW_LOGS?, REVIEW_HOURS?, REVIEW_DRUG_ALCOHOL?, REVIEW_LICENSE?, REVIEW_TRAFFIC?,
REVIEW_PAPERS?, REVIEW_PLACARDS?, REVIEW_CARGO_TANK?, REVIEW_OTHER?,
PRIOR_ENFORCEMENT_CASES?, FOLLOW_UP_CODE?, MCSIP_FLAG?, MCSIP_LEVEL?, MCSIP_LEVEL_DATE?,
MCSIP_ENTRY_DATE?, SAFESTAT_RUN_INDICATOR?, SAFESTAT_DATE?, SAFESTAT_ACCIDENT_SEA?,
SAFESTAT_CATEGORY?, SAFESTAT_DRIVER_SEA?, SAFESTAT_LETTERS?, SAFESTAT_LETTER_DATE?,
SAFESTAT_MANAGEMENT_SEA?, SAFESTAT_INDICATOR?, SAFESTAT_VEHICLE_SEA?,
HAZMAT_PASSENGER_SCORE?, HAZMAT_PASSENGER_SCORE_DATE?, SNET_FATAL_ACCIDENTS_LAST24?,
SNET_INJURY_ACCIDENTS_LAST24?, SNET_TOWAWAY_ACCIDENTS_LAST24?,
SNET_OTHER_ACCIDENTS_LAST24?, SNET_TOTAL_ACCIDENTS_LAST24?, SNET_FATAL_ACCIDENTS_LAST15?,
SNET_INJURY_ACCIDENTS_LAST15?, SNET_TOWAWAY_ACCIDENTS_LAST15?,
SNET_OTHER_ACCIDENTS_LAST15?, SNET_TOTAL_ACCIDENTS_LAST15?, SNET_FATAL_ACCIDENTS_LAST30?,
SNET_INJURY_ACCIDENTS_LAST30?, SNET_TOWAWAY_ACCIDENTS_LAST30?,
SNET_OTHER_ACCIDENTS_LAST30?, SNET_TOTAL_ACCIDENTS_LAST30?, STATE_DATA?,
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NAME_ALPHABETIZER?, NAME_ALPHABETIZER2?, ISS_SCORE?, ISS_SCORE_DATE?, ISS_INDICATOR?,
DUNS_NUMBER?, FEDERAL_OP_AUTH_ID?, FEDERAL_OP_AUTH_STATUS?, FEDERAL_OP_AUTH_ISSUED_DATE?,
FEDERAL_OP_AUTH_RENEW_DATE?, FEDERAL_OP_AUTH_BASE_STATE?, FEDERAL_OP_AUTH_AGENCY?,
HAZMAT_REG_STATUS?, HAZMAT_REG_STATUS_DATE?, HAZMAT_REG_NUMBER?, HAZMAT_REG_DATE?,
HAZMAT_REG_BASE_STATE?, INSURANCE_TYPE?, INSURANCE_COVERAGE_LEVEL?,
INSURANCE_HAZMAT_LEVEL?, FUEL_USE_PERMIT_FLAG?, FUEL_USE_PERMIT_DATE?, CARRIER_IFTA?,
OOS_REPORT_NUMBER?, OOS_DATETIME?, OOS_REASON?, OOS_STATUS?, MCS150_MILEAGE?,
MCS150_MILEAGE_YEAR?, MCS150_UPDATE_DATE?, MCS150_UPDATE_FLAG?, NAMES?, CARRIER_CARGO*,
CARRIER_CLASS*, CARRIER_HAZMAT*, CARRIER_ESCREEN*, CARRIER_REVIEW*, CARRIER_IRP*,
CARRIER_LI_PRIMARY*)>
<!ELEMENT CARRIER_ACTION (#PCDATA)>
<!ELEMENT CARRIER_ACTION_DATE (#PCDATA)>
<!ELEMENT CARRIER_CARGO (CARGO_CODE, CARGO_OTHER_DESC?)>
<!ELEMENT CARRIER_CLASS (CLASS_CODE, CLASS_OTHER_DESC?)>
<!ELEMENT CARRIER_ESCREEN (JURISDICTION_CODE, ACTIVITY_CODE, CARRIER_ACTION,
CARRIER_ACTION_DATE?, JURISDICTION_ACTION, JURISDICTION_ACTION_DATE?)>
<!ELEMENT CARRIER_HAZMAT (HAZMAT_CODE, HAZMAT_CARRIED_SHIPPED, BULK_NONBULK)>
<!ELEMENT CARRIER_HAZMAT_PLACARDED (#PCDATA)>
<!ELEMENT CARRIER_ID_NUMBER (#PCDATA)>
<!ELEMENT CARRIER_IFTA (IFTA_REG_BASE_COUNTRY_CODE?, IFTA_REG_BASE_STATE?,
IFTA_REG_LICENSE_NUMBER?, IFTA_REG_STATUS?, IFTA_REG_STATUS_DATE?, IFTA_REG_ISSUE_DATE?,
IFTA_REG_EXPIRE_DATE?, NAMES?)>
<!ELEMENT CARRIER_INTERSTATE (#PCDATA)>
<!ELEMENT CARRIER_INTERSTATE_HM (#PCDATA)>
<!ELEMENT CARRIER_INTERSTATE_NHM (#PCDATA)>
<!ELEMENT CARRIER_INTRASTATE_HM (#PCDATA)>
<!ELEMENT CARRIER_INTRASTATE_NHM (#PCDATA)>
<!ELEMENT CARRIER_IRP (IRP_BASE_COUNTRY, IRP_BASE_STATE, IRP_ACCT_NUM,
JUR_REG_ACCOUNT_TYPE, IRP_ACCT_CHECK_FLAG, IRP_ACCT_CHECK_DATE, NAMES*,
CARRIER_IRP_FLEET*)>
<!ELEMENT CARRIER_IRP_FLEET (IRP_FLEET_NUMBER, IRP_FLEET_CHECK_FLAG,
IRP_FLEET_CHECK_DATE, IRP_FLEET_EXPIRE_DATE, NAMES*)>
<!ELEMENT CARRIER_LI_DETAIL (INSURANCE_TYPE, INSURER?, POLICY_NUMBER?,
POLICY_EFFECTIVE_DATE?, COVERAGE_LOW_AMOUNT?, COVERAGE_HIGH_AMOUNT?,
CANCELLATION_EFFECTIVE_DATE?, DATA_EFFECTIVE_DATE?)>
<!ELEMENT CARRIER_LI_PRIMARY (DOCKET_NUMBER, PREFIX?, INSURANCE_ENTITY_NAME?,
INSURANCE_DBA_NAME?, MEXICAN_TERRITORY, COMMON_AUTHORITY_STATUS,
CONTRACT_AUTHORITY_STATUS, BROKER_AUTHORITY_STATUS, LIABILITY_INSURANCE_AMOUNT?,
LIABILITY_INSURANCE_REQD, LIABILITY_INSURANCE_STATUS, LIABILITY_INSURANCE_SUMMARY?,
CARGO_INSURANCE_REQD, CARGO_INSURANCE_STATUS, CARGO_INSURANCE_SUMMARY?,
BOND_TRUST_FUND_REQD, BOND_TRUST_FUND_STATUS, BOND_TRUST_FUND_SUMMARY?,
DATA_EFFECTIVE_DATE?, CARRIER_LI_DETAIL*)>
<!ELEMENT CARRIER_NAME (#PCDATA)>
<!ELEMENT CARRIER_RATEABLE (#PCDATA)>
<!ELEMENT CARRIER_REVIEW (REVIEW_DATE?, SAFETY_RATING?, SAFETY_RATING_FACTOR_1?,
SAFETY_RATING_FACTOR_2?, SAFETY_RATING_FACTOR_3?, SAFETY_RATING_FACTOR_4?,
SAFETY_RATING_FACTOR_5?, SAFETY_RATING_FACTOR_6?, RATING_DATE?, REVIEW_TYPE?,
REVIEW_CITY?, REVIEW_STATE?, REVIEW_INVESTIGATOR_CODE?, REVIEW_REASON_INITIAL_CONTACT?,
REVIEW_REASON_COMPLAINT?, REVIEW_REASON_PRIORITY_LIST?, REVIEW_REASON_ENF_FOLLOW_UP?,
REVIEW_REASON_CARRIER_REQUEST?, REVIEW_REASON_NOT_RATED?, REVIEW_REASON_OTHER?,
REVIEW_REASON_OTHER_DESC?, RECORDABLE_CRASHES?, MILEAGE?, VEH_CHECKED_FROM_PROFILE?,
OOS_VEH_CHECKED_FROM_PROFILE?, VEH_CHECKED_DURING_REVIEW?,
OOS_VEH_CHECKED_DURING_REVIEW?, PLANNED_ACTION_COMPLIANCE_MON?,
PLANNED_ACTION_PROSECUTION?, PLANNED_ACTION_OOS_ORDER?, PLANNED_ACTION_ADMIN_HANDLING?,
PLANNED_ACTION_OTHER?, PLANNED_ACTION_OTHER_DESC?)>
<!ELEMENT CITY (#PCDATA)>
<!ELEMENT CLASS_CODE (#PCDATA)>
<!ELEMENT CLASS_OTHER_DESC (#PCDATA)>
<!ELEMENT COLONIA (#PCDATA)>
<!ELEMENT COMMON_AUTHORITY_STATUS (#PCDATA)>
<!ELEMENT CONTRACT_AUTHORITY_STATUS (#PCDATA)>
<!ELEMENT COUNTRY (#PCDATA)>
<!ELEMENT COUNTY (#PCDATA)>
<!ELEMENT COUNTY_CODE (#PCDATA)>
<!ELEMENT COVERAGE_HIGH_AMOUNT (#PCDATA)>
<!ELEMENT COVERAGE_LOW_AMOUNT (#PCDATA)>
<!ELEMENT DATA_EFFECTIVE_DATE (#PCDATA)>
<!ELEMENT DATE_ADDED (#PCDATA)>
<!ELEMENT DBA_NAME (#PCDATA)>
<!ELEMENT DOCKET_NUMBER (#PCDATA)>
<!ELEMENT DRIVER_INSPECTIONS_LAST15 (#PCDATA)>
<!ELEMENT DRIVER_INSPECTIONS_LAST24 (#PCDATA)>
<!ELEMENT DRIVER_INSPECTIONS_LAST30 (#PCDATA)>
<!ELEMENT DUNS_NUMBER (#PCDATA)>
<!ELEMENT EMAIL_ADDRESS (#PCDATA)>
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<!ELEMENT ENTITY_TYPE (#PCDATA)>
<!ELEMENT FAX_NUMBER (#PCDATA)>
<!ELEMENT FEDERAL_OP_AUTH_AGENCY (#PCDATA)>
<!ELEMENT FEDERAL_OP_AUTH_BASE_STATE (#PCDATA)>
<!ELEMENT FEDERAL_OP_AUTH_ID (#PCDATA)>
<!ELEMENT FEDERAL_OP_AUTH_ISSUED_DATE (#PCDATA)>
<!ELEMENT FEDERAL_OP_AUTH_RENEW_DATE (#PCDATA)>
<!ELEMENT FEDERAL_OP_AUTH_STATUS (#PCDATA)>
<!ELEMENT FILE_CREATE_DATE (#PCDATA)>
<!ELEMENT FILE_NAME (#PCDATA)>
<!ELEMENT FIRST_NAME (#PCDATA)>
<!ELEMENT FOLLOW_UP_CODE (#PCDATA)>
<!ELEMENT FUEL_USE_PERMIT_DATE (#PCDATA)>
<!ELEMENT FUEL_USE_PERMIT_FLAG (#PCDATA)>
<!ELEMENT HAZMAT_CARRIED_SHIPPED (#PCDATA)>
<!ELEMENT HAZMAT_CODE (#PCDATA)>
<!ELEMENT HAZMAT_PASSENGER_SCORE (#PCDATA)>
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<!ELEMENT HAZMAT_REG_BASE_STATE (#PCDATA)>
<!ELEMENT HAZMAT_REG_DATE (#PCDATA)>
<!ELEMENT HAZMAT_REG_NUMBER (#PCDATA)>
<!ELEMENT HAZMAT_REG_STATUS (#PCDATA)>
<!ELEMENT HAZMAT_REG_STATUS_DATE (#PCDATA)>
<!ELEMENT HAZMAT_STATUS (#PCDATA)>
<!ELEMENT ICC_NUMBER_1 (#PCDATA)>
<!ELEMENT ICC_NUMBER_2 (#PCDATA)>
<!ELEMENT ICC_NUMBER_3 (#PCDATA)>
<!ELEMENT IFTA_REG_BASE_COUNTRY_CODE (#PCDATA)>
<!ELEMENT IFTA_REG_BASE_STATE (#PCDATA)>
<!ELEMENT IFTA_REG_EXPIRE_DATE (#PCDATA)>
<!ELEMENT IFTA_REG_ISSUE_DATE (#PCDATA)>
<!ELEMENT IFTA_REG_LICENSE_NUMBER (#PCDATA)>
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<!ELEMENT IFTA_REG_STATUS_DATE (#PCDATA)>
<!ELEMENT INSURANCE_COVERAGE_LEVEL (#PCDATA)>
<!ELEMENT INSURANCE_DBA_NAME (#PCDATA)>
<!ELEMENT INSURANCE_ENTITY_NAME (#PCDATA)>
<!ELEMENT INSURANCE_HAZMAT_LEVEL (#PCDATA)>
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<!ELEMENT IRP_ACCT_CHECK_FLAG (#PCDATA)>
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<!ELEMENT IRP_BASE_COUNTRY (#PCDATA)>
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<!ELEMENT ISS_INDICATOR (#PCDATA)>
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<!ELEMENT JUR_REG_ACCOUNT_TYPE (#PCDATA)>
<!ELEMENT JURISDICTION_ACTION (#PCDATA)>
<!ELEMENT JURISDICTION_ACTION_DATE (#PCDATA)>
<!ELEMENT JURISDICTION_CODE (#PCDATA)>
<!ELEMENT LAST_UPDATE_DATE (#PCDATA)>
<!ELEMENT LAST_UPDATE_USERID (#PCDATA)>
<!ELEMENT LIABILITY_INSURANCE_AMOUNT (#PCDATA)>
<!ELEMENT LIABILITY_INSURANCE_REQD (#PCDATA)>
<!ELEMENT LIABILITY_INSURANCE_STATUS (#PCDATA)>
<!ELEMENT LIABILITY_INSURANCE_SUMMARY (#PCDATA)>
<!ELEMENT MAIL_CITY (#PCDATA)>
<!ELEMENT MAIL_COLONIA (#PCDATA)>
<!ELEMENT MAIL_COUNTY_CODE (#PCDATA)>
<!ELEMENT MAIL_STATE (#PCDATA)>
<!ELEMENT MAIL_STREET (#PCDATA)>
<!ELEMENT MAIL_ZIP_CODE (#PCDATA)>
<!ELEMENT MCMIS_REASON_INACTIVATED (#PCDATA)>
<!ELEMENT MCMIS_STATUS (#PCDATA)>
<!ELEMENT MCMIS_STATUS_DATE (#PCDATA)>
<!ELEMENT MCMIS_TRANSACTION_DATE (#PCDATA)>
<!ELEMENT MCS150_MILEAGE (#PCDATA)>
<!ELEMENT MCS150_MILEAGE_YEAR (#PCDATA)>
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<!ELEMENT MCS150_UPDATE_DATE (#PCDATA)>
<!ELEMENT MCS150_UPDATE_FLAG (#PCDATA)>
<!ELEMENT MCSIP_ENTRY_DATE (#PCDATA)>
<!ELEMENT MCSIP_FLAG (#PCDATA)>
<!ELEMENT MCSIP_LEVEL (#PCDATA)>
<!ELEMENT MCSIP_LEVEL_DATE (#PCDATA)>
<!ELEMENT MEXICAN_TERRITORY (#PCDATA)>
<!ELEMENT MIDDLE_NAME (#PCDATA)>
<!ELEMENT MILEAGE (#PCDATA)>
<!ELEMENT NAMES (NAME_TYPE, BUSINESS_OR_LAST_NAME, FIRST_NAME?, MIDDLE_NAME?,
SALUTATION?, TITLE?, SUB_TITLE?, ADDRESSES+)>
<!ELEMENT NAME_ALPHABETIZER (#PCDATA)>
<!ELEMENT NAME_ALPHABETIZER2 (#PCDATA)>
<!ELEMENT NAME_TYPE (#PCDATA)>
<!ELEMENT OIC_NUMBER (#PCDATA)>
<!ELEMENT OOS_ALL_TYPES_LAST15 (#PCDATA)>
<!ELEMENT OOS_ALL_TYPES_LAST24 (#PCDATA)>
<!ELEMENT OOS_ALL_TYPES_LAST30 (#PCDATA)>
<!ELEMENT OOS_DATETIME (#PCDATA)>
<!ELEMENT OOS_DRIVER_INSPECTIONS_LAST15 (#PCDATA)>
<!ELEMENT OOS_DRIVER_INSPECTIONS_LAST24 (#PCDATA)>
<!ELEMENT OOS_DRIVER_INSPECTIONS_LAST30 (#PCDATA)>
<!ELEMENT OOS_HAZMAT_INSPECTIONS_LAST15 (#PCDATA)>
<!ELEMENT OOS_HAZMAT_INSPECTIONS_LAST24 (#PCDATA)>
<!ELEMENT OOS_HAZMAT_INSPECTIONS_LAST30 (#PCDATA)>
<!ELEMENT OOS_REASON (#PCDATA)>
<!ELEMENT OOS_REPORT_NUMBER (#PCDATA)>
<!ELEMENT OOS_STATUS (#PCDATA)>
<!ELEMENT OOS_VEHICLE_INSPECTIONS_LAST15 (#PCDATA)>
<!ELEMENT OOS_VEHICLE_INSPECTIONS_LAST24 (#PCDATA)>
<!ELEMENT OOS_VEHICLE_INSPECTIONS_LAST30 (#PCDATA)>
<!ELEMENT OOS_VEH_CHECKED_DURING_REVIEW (#PCDATA)>
<!ELEMENT OOS_VEH_CHECKED_FROM_PROFILE (#PCDATA)>
<!ELEMENT PLANNED_ACTION_ADMIN_HANDLING (#PCDATA)>
<!ELEMENT PLANNED_ACTION_COMPLIANCE_MON (#PCDATA)>
<!ELEMENT PLANNED_ACTION_OOS_ORDER (#PCDATA)>
<!ELEMENT PLANNED_ACTION_OTHER (#PCDATA)>
<!ELEMENT PLANNED_ACTION_OTHER_DESC (#PCDATA)>
<!ELEMENT PLANNED_ACTION_PROSECUTION (#PCDATA)>
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<!ELEMENT POLICY_NUMBER (#PCDATA)>
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<!ELEMENT PREVENTABLE_CRASHES (#PCDATA)>
<!ELEMENT PREV_TRACKING_SEQ_NUM (#PCDATA)>
<!ELEMENT PRIOR_DATE (#PCDATA)>
<!ELEMENT PRIOR_ENFORCEMENT_CASES (#PCDATA)>
<!ELEMENT QUANTITY_CARS (#PCDATA)>
<!ELEMENT QUANTITY_DRIVERS (#PCDATA)>
<!ELEMENT QUANTITY_DRIVERS_CDL (#PCDATA)>
<!ELEMENT QUANTITY_DRIVERS_INTERSTATE (#PCDATA)>
<!ELEMENT QUANTITY_DRIVERS_INTRASTATE (#PCDATA)>
<!ELEMENT QUANTITY_HAZMAT_PRESENT_LAST15 (#PCDATA)>
<!ELEMENT QUANTITY_HAZMAT_PRESENT_LAST24 (#PCDATA)>
<!ELEMENT QUANTITY_HAZMAT_PRESENT_LAST30 (#PCDATA)>
<!ELEMENT QUANTITY_HAZMAT_TANK_TRAILERS (#PCDATA)>
<!ELEMENT QUANTITY_HAZMAT_TANK_TRUCKS (#PCDATA)>
<!ELEMENT QUANTITY_INSPECTIONS_LAST15 (#PCDATA)>
<!ELEMENT QUANTITY_INSPECTIONS_LAST24 (#PCDATA)>
<!ELEMENT QUANTITY_INSPECTIONS_LAST30 (#PCDATA)>
<!ELEMENT QUANTITY_LIMOS (#PCDATA)>
<!ELEMENT QUANTITY_MOTOR_COACHES (#PCDATA)>
<!ELEMENT QUANTITY_POWER_UNITS (#PCDATA)>
<!ELEMENT QUANTITY_SCHOOL_BUSES (#PCDATA)>
<!ELEMENT QUANTITY_TRAILERS (#PCDATA)>
<!ELEMENT QUANTITY_TRUCKS (#PCDATA)>
<!ELEMENT QUANTITY_TRUCK_TRACTORS (#PCDATA)>
<!ELEMENT QUANTITY_VANS (#PCDATA)>
<!ELEMENT RATING_DATE (#PCDATA)>
<!ELEMENT RECORDABLE_CRASHES (#PCDATA)>
<!ELEMENT REGION_CODE (#PCDATA)>
<!ELEMENT REVIEW_CARGO_TANK (#PCDATA)>
<!ELEMENT REVIEW_CITY (#PCDATA)>
<!ELEMENT REVIEW_DATE (#PCDATA)>
<!ELEMENT REVIEW_DRUG_ALCOHOL (#PCDATA)>
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<!ELEMENT REVIEW_HOURS (#PCDATA)>
<!ELEMENT REVIEW_INVESTIGATOR_CODE (#PCDATA)>
<!ELEMENT REVIEW_LICENSE (#PCDATA)>
<!ELEMENT REVIEW_LOGS (#PCDATA)>
<!ELEMENT REVIEW_MEDICAL_CERTIFICATE (#PCDATA)>
<!ELEMENT REVIEW_OTHER (#PCDATA)>
<!ELEMENT REVIEW_PAPERS (#PCDATA)>
<!ELEMENT REVIEW_PLACARDS (#PCDATA)>
<!ELEMENT REVIEW_REASON_CARRIER_REQUEST (#PCDATA)>
<!ELEMENT REVIEW_REASON_COMPLAINT (#PCDATA)>
<!ELEMENT REVIEW_REASON_ENF_FOLLOW_UP (#PCDATA)>
<!ELEMENT REVIEW_REASON_INITIAL_CONTACT (#PCDATA)>
<!ELEMENT REVIEW_REASON_NOT_RATED (#PCDATA)>
<!ELEMENT REVIEW_REASON_OTHER (#PCDATA)>
<!ELEMENT REVIEW_REASON_OTHER_DESC (#PCDATA)>
<!ELEMENT REVIEW_REASON_PRIORITY_LIST (#PCDATA)>
<!ELEMENT REVIEW_STATE (#PCDATA)>
<!ELEMENT REVIEW_TRAFFIC (#PCDATA)>
<!ELEMENT REVIEW_TYPE (#PCDATA)>
<!ELEMENT SAFER_UPDATE_PACKAGE (SAFER_UPDATE_PACKAGE_HEADER,
SAFER_UPDATE_PACKAGE_TRANSACTION+)>
<!ELEMENT SAFER_UPDATE_PACKAGE_HEADER (SOURCE_COUNTRY_CODE, SOURCE_JUR_CODE,
SOURCE_AGENCY_NAME, SOURCE_AGENCY_CONTACT_NAME, SOURCE_AGENCY_CONTACT_PHONE_NUM,
SUBMISSION_DATE_TIME, TRACKING_SEQ_NUM, PREV_TRACKING_SEQ_NUM, VIEW_NAME, VIEW_VERSION,
FILE_NAME, TOTAL_TRANSACTION_COUNT)>
<!ELEMENT SAFER_UPDATE_PACKAGE_TRANSACTION (CARRIER)>
<!ELEMENT SAFESTAT_ACCIDENT_SEA (#PCDATA)>
<!ELEMENT SAFESTAT_CATEGORY (#PCDATA)>
<!ELEMENT SAFESTAT_DATE (#PCDATA)>
<!ELEMENT SAFESTAT_DRIVER_SEA (#PCDATA)>
<!ELEMENT SAFESTAT_INDICATOR (#PCDATA)>
<!ELEMENT SAFESTAT_LETTERS (#PCDATA)>
<!ELEMENT SAFESTAT_LETTER_DATE (#PCDATA)>
<!ELEMENT SAFESTAT_MANAGEMENT_SEA (#PCDATA)>
<!ELEMENT SAFESTAT_RUN_INDICATOR (#PCDATA)>
<!ELEMENT SAFESTAT_VEHICLE_SEA (#PCDATA)>
<!ELEMENT SAFETY_RATING (#PCDATA)>
<!ELEMENT SAFETY_RATING_FACTOR_1 (#PCDATA)>
<!ELEMENT SAFETY_RATING_FACTOR_2 (#PCDATA)>
<!ELEMENT SAFETY_RATING_FACTOR_3 (#PCDATA)>
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<!ELEMENT SAFETY_RATING_FACTOR_5 (#PCDATA)>
<!ELEMENT SAFETY_RATING_FACTOR_6 (#PCDATA)>
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<!ELEMENT SHIPPER_INTERSTATE (#PCDATA)>
<!ELEMENT SHIPPER_INTERSTATE_HM (#PCDATA)>
<!ELEMENT SHIPPER_INTRASTATE_HM (#PCDATA)>
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<!ELEMENT SNET_FATAL_ACCIDENTS_LAST24 (#PCDATA)>
<!ELEMENT SNET_FATAL_ACCIDENTS_LAST30 (#PCDATA)>
<!ELEMENT SNET_INJURY_ACCIDENTS_LAST15 (#PCDATA)>
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<!ELEMENT SNET_OTHER_ACCIDENTS_LAST15 (#PCDATA)>
<!ELEMENT SNET_OTHER_ACCIDENTS_LAST24 (#PCDATA)>
<!ELEMENT SNET_OTHER_ACCIDENTS_LAST30 (#PCDATA)>
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<!ELEMENT SNET_TOTAL_ACCIDENTS_LAST24 (#PCDATA)>
<!ELEMENT SNET_TOTAL_ACCIDENTS_LAST30 (#PCDATA)>
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<!ELEMENT SOURCE_AGENCY_CONTACT_PHONE_NUM (#PCDATA)>
<!ELEMENT SOURCE_AGENCY_NAME (#PCDATA)>
<!ELEMENT SOURCE_COUNTRY_CODE (#PCDATA)>
<!ELEMENT SOURCE_JUR_CODE (#PCDATA)>
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<!ELEMENT STATE_DATA (#PCDATA)>
<!ELEMENT STREET (#PCDATA)>
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<!ELEMENT SUB_TITLE (#PCDATA)>
<!ELEMENT TAX_ID_NUMBER (#PCDATA)>
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<!ELEMENT VEHICLE_INSPECTIONS_LAST30 (#PCDATA)>
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<!ELEMENT VEH_CHECKED_FROM_PROFILE (#PCDATA)>
<!ELEMENT VIEW_NAME (#PCDATA)>
<!ELEMENT VIEW_VERSION (#PCDATA)>
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<!ELEMENT VIOLATION_DRUGS (#PCDATA)>
<!ELEMENT VIOLATION_HOURS (#PCDATA)>
<!ELEMENT VIOLATION_LICENSE (#PCDATA)>
<!ELEMENT VIOLATION_LIGHTS (#PCDATA)>
<!ELEMENT VIOLATION_LOGS (#PCDATA)>
<!ELEMENT VIOLATION_MEDICAL_CERTIFICATE (#PCDATA)>
<!ELEMENT VIOLATION_OP_EMER_RESP (#PCDATA)>
<!ELEMENT VIOLATION_OTHER (#PCDATA)>
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<!ELEMENT VIOLATION_PLACARDS (#PCDATA)>
<!ELEMENT VIOLATION_STEERING (#PCDATA)>
<!ELEMENT VIOLATION_TANK (#PCDATA)>
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<!ELEMENT ZIP_CODE (#PCDATA)>
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